Draft
Engineering Evaluation
And Cost Analysis

Omega Chemical Superfund Site
Operable Unit One
Whittier, California

July 18, 2005 with EPA's revisions and comments

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List of Acronyms

ALs - Action Levels

AOP - advanced oxidation process

ARARs - Applicable or Relevant and Appropriate Requirements

ASTM – American Society of Testing Materials

bgs - below ground surface

BMPs - best management practices

CAA - Clean Air Act

CALs - California Action Levels

CCR - California Code of Regulations

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act

CFM – chloroform

cis-1,2-DCE - *cis*-1,2-dichloroethene

COPC - contaminants of potential concern

CSDLAC - County Sanitation Districts of Los Angeles County

CTC - carbon tetrachloride

CWA - Clean Water Act

1,1-DCA – 1,1-dichloroethane

1,1-DCE – 1,1-dichlorethene

DNAPL - dense non-aqueous phase liquid

DWELs - Drinking Water Exposure Limits

EAB - enhanced anaerobic biodegradation

EE/CA – Engineering Evaluation/Cost Analysis

H&SC – Health and Safety Code

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HEAs - Health Effects Advisories

hp – horsepower

HSWA - Hazardous and Solid Waste Amendments of 1984

MC - methylene chloride

MCL - maximum contaminant level

MCLGs - Maximum Contaminant Level Goals

MCLs - Maximum Contaminant Levels

mg/L - milligrams per liter

MSL - mean sea level

MTBE - methyl tertiary butyl ether

NELCO - New England Lead Burning Company

NHPA - National Historic Preservation Act

NPDES - National Pollutant Discharge Elimination System

OEHHA - Office of Environmental Health Hazard Assessment

OPOG – Omega Chemical Site PRP Organized Group

1,1,1,2-PCA – 1,1,1,2-tetrachloroethane

PCE – tetrachloroethene

PHGs - Public Health Goals

POTWs - publicly-owned treatment works

PRGs – Preliminary Remediation Goals

PZ – piezometer

RAOs - Removal Action Objectives

RCRA - Resource Conservation and Recovery Act

RWQCB - Regional Water Quality Control Board

SCAQMD - South Coast Air Quality Management District

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SDWA - Safe Drinking Water Act

SRE - streamlined risk evaluation

SVOCs - semi-volatile organic compounds

SWRCB - State Water Resources Control Board

T-BACT - best available control technology for toxics

TBCs - to be considered

1,1,1-TCA – 1,1,1-trichloroethane

TCE – trichloroethene

TDS – total dissolved solids

TEAP - terminal electron acceptor process

TS - treatability study

TSDFs - Treatment, Storage, and Disposal Facilities

$\mu g/L$ – micrograms per liter

USEPA – United States Environmental Protection Agency

UST - underground storage tank

VC - vinyl chloride

VOCs – volatile organic compounds

WDR - Waste Discharge Requirements

WRR - Water Reclamation Requirements

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Executive Summary

The overall purpose of this Engineering Evaluation/Cost Analysis (EE/CA) is to provide a framework for, and documentation of, the evaluation and selection of removal action alternatives that pertain to groundwater contamination on the Omega Chemical Phase 1a Area. The Phase 1a Area is the equivalent of the Operable Unit One (OU-1) of the Omega Chemical Superfund Site (Site). The removal actions considered in this document are only one component of the overall remedy that will address contamination associated with the Site. Other components will include remedies that will address soils on the former Omega property.

An EE/CA is similar to a focused feasibility study, in that it provides summary information about the nature and extent of contamination and the related risks and then evaluates alternatives aimed at removing site contamination and reducing the associated risks. Since the scope of this evaluation covers only groundwater within OU-1, the removal actions that have been selected for evaluation were chosen mainly because they provide containment migration control and remove contaminant mass from groundwater associated with OU-1. The selected removal action alternatives are all evaluated, with no initial screening of alternatives as is typically done for a feasibility study, and in this sense the EE/CA is more streamlined than a feasibility study.

The specific Removal Action Objectives (RAOs) for this EE/CA are:

1. Provide horizontal and vertical containment within the Phase 1a Area of groundwater contamination associated with the Omega property.

2. Meet air emission and water treatment standards associated with the treatment and/or reuse of extracted groundwater.

Three removal action alternatives have been defined and evaluated in this report:

Alternative 1: Source Area Contaminant Mass Removal from Groundwater

This alternative provides for 14 groundwater extraction wells in the suspected source area where contaminant concentrations are the highest to maximize removal of contaminant mass. A treatment system on or adjacent to the former Omega property would treat extracted groundwater which would then be discharged to surface water/storm drain or sanitary sewer.

Alternative 2: Putnam Street Hydraulic Containment for Groundwater

This alternative includes five groundwater extraction wells along Putnam Street. Pumping from these wells would contain the plume and minimize further migration of contaminants beyond Putnam Street. Extracted groundwater would be treated by a treatment system located on or adjacent to the former Omega property. After treatment, extracted groundwater would be discharged to surface water/storm drain or sanitary sewer.

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Alternative 3: Putnam Street Hydraulic Containment for Groundwater with Re-injection for Enhanced Anaerobic Biodegradation

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This alternative is similar to Alternative 2, with the exception that a portion of the treated groundwater would be mixed with amendments and re-injected in the source area to stimulate enhanced anaerobic biodegradation (EAB) and expedite the removal of groundwater contaminants in the source area.

Compared to Alternative 1, Alternatives 2 and 3 have significantly higher ratings for reduction of contaminant mobility and overall protection of human health and the environment due to their ability to provide superior contaminant migration control downgradient of the former Omega property. Additionally, Alternative 3 provides greater contaminant mass destruction via treatment when compared to Alternatives 1 and 2.

Although contaminant mass removal is not a RAO, Alternative 3 offers additional benefits by reducing contaminant mass up gradient of the containment system. However, Alternative 3 rates significantly lower for some other evaluation criteria (e.g., higher cost and lower short term effectiveness due to risks and access issues associated with construction of the injection trench) because of implementation issues regarding re-injection of treated groundwater for EAB. Since the additional implementation issues and higher cost associated with Alternative 3 are not off set by the additional benefits it provides, Alternative 2 is the recommended alternative.

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Section 1
Introduction

1.1 Scope and Objectives

The overall purpose of this Engineering Evaluation/Cost Analysis (EE/CA) is to provide a framework for, and documentation of, the evaluation and selection of removal action alternatives that pertain to groundwater contamination on the Omega Chemical Phase 1a Area. The Phase 1a Area is the equivalent of the Operable Unit One (OU-1) of the Omega Chemical Superfund Site (Site). The removal actions considered in this document are only one component of the overall remedy that will address contamination associated with the Site. Other components will include remedies that will address OU-1 soils.

An EE/CA is similar to a focused feasibility study, in that it provides summary information about the nature and extent of contamination and the related risks and then evaluates alternatives aimed at removing site contamination and reducing the associated risks. Since the scope of this evaluation covers only groundwater within OU-1, the removal actions that have been selected for evaluation were chosen mainly because they provide containment migration control and remove contaminant mass from groundwater associated with OU-1. The selected removal action alternatives are all evaluated, with no initial screening of alternatives as is typically done for a feasibility study, and in this sense the EE/CA is more streamlined than a feasibility study.

The goals of the EE/CA are to identify the objectives of the removal action (Section 3) and to analyze the effectiveness, implementability and cost of various alternatives that would meet these objectives (Sections 4 and 5). Based on this analysis, one removal action alternative is recommended for implementation (Section 6).

1.2 USEPA Consent Decree

This document has been prepared in accordance with Task 1 of the Statement of Work in Consent Decree No. 00-12471 between the United States Environmental Protection Agency (USEPA) and the Omega Chemical Site PRP Organized Group (OPOG). The Consent Decree was lodged on November 24, 2000 and entered into the US District Court on February 28, 2001.

Task 1 requires OPOG to 'Design and Implement a Groundwater Containment and Mass Removal Treatment System in the Phase 1a Area.' The Consent Decree defines the Phase 1a area as 'the area of soil and groundwater contamination associated with the Omega Property and extending downgradient approximately 100 feet southwest of Putnam Street, Whittier, California'. The Site location and vicinity are illustrated on Figure 1-1, and the Phase 1a area is illustrated on Figure 1-2.

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1.3 Site Background

The following section is a summary of information regarding previous owners, operations, and known historical chemical use at and in the vicinity of the Site.

1.3.1 Owners and Operators

The former Omega property located at 12504/12512 East Whittier Boulevard was first developed in 1951. It occupies Los Angeles County Assessor Tract No. 13486, Lots 3 and 4. The former Omega property is approximately 41,000 square feet in area (200 feet wide x 205 feet long) and contains two structures – an approximate 140 by 50 foot warehouse and an approximate 80 by 30 foot administrative building. A loading dock is also attached to the rear of the warehouse. The exterior areas are concrete-paved and the former Omega property is secured with a perimeter fence and locking gate.

Prior to construction of the buildings in July 1951, the former Omega property was used for agriculture. It was operated by Sierra Bullets prior to 1963. During operation of the Sierra Bullet facility, a 500-gallon underground storage tank (UST) was utilized for storage of kerosene. The UST was subsequently removed in 1987 by Fred R. Rippy, Inc.

From 1976 to 1991 Omega Chemical Corporation operated a treatment and disposal facility for commercial and industrial solid and liquid wastes and a transfer station for storage and consolidation of wastes for shipment to other treatment and/or disposal facilities.

Van Owen Holdings LLC of Los Angeles, California purchased the property in 2003. Star City Auto Body occupies the warehouse (12504 Whittier Blvd.) and has performed auto body repair and painting on the premises. The auto body shop also leases the small paved parking lot north of the warehouse building for automobile parking. 3 Kings Construction has occupied the former administrative building (12512 Whittier Blvd.) and larger paved parking area south of the warehouse. The building is utilized for office space, and the parking lot is used for temporary storage and parking of construction vehicles and equipment.

1.3.2 Facility Processes and Chemical Usage

Limited information regarding volumes and types of wastes handled by the Omega Chemical Corporation is available for review. According to the Phase II Close Out Report (Hargis and Associates, England and Associates, October 1, 1996), Omega Chemical Corporation operated the facility for recycling and treatment of spent solvents and refrigerants. Drums and bulk loads of waste solvents and chemicals (primarily chlorinated hydrocarbons and chlorofluorocarbons) from various industrial activities were processed to form commercial products which were returned to generators or sold in the marketplace. An Operation Plan, prepared by Omega Chemical Corporation in 1990 for proposed expansion of the facility, provided

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a summary of current and proposed facility processes, tank capacities, incoming and facility-generated waste stream characteristics and handling practices, etc.

The majority of the 11 treatment units were located in the general area of the warehouse loading dock. As indicated in the Operation Plan, a total of 27 storage tanks with a combined storage capacity of 109,400 gallons were present at the facility in 1990. Six large, vertical storage tanks were arranged in an L-shaped pattern in the southern corner of the former Omega property. Five process tanks were located in the northern yard, and were arranged in a linear pattern along the side of the warehouse. The locations of the smaller storage tanks were not indicated in the Operation Plan. With respect to the potential for contaminant releases, the locations of tanks provide a general sense of possible source locations. However, pathways to groundwater are better defined by subsurface data, collection of which is ongoing under the onsite soils RI/FS.

Wastes accepted by Omega Chemical Corporation for recycling were broadly characterized as organic solvents and chemicals, and aqueous wastes with organic waste constituents. Sources of the incoming waste were a wide assortment of manufacturing and industrial processes (petroleum refining, rubber and plastics, chemicals, paper and allied products, furniture and fixture products, lumber and wood products, printing and publishing, textile mill products, food and kindred products, refrigerants, etc.). Most of the wastes reportedly arrived at the property manifested under a few common EPA waste codes (e.g., D001, ignitable waste; and F001 through F005, halogenated and non-halogenated waste). According to the Operations Plan, typical Omega-generated waste consisted of the following: C6 to C11 aliphatics (43.4 percent), xylene (16 percent), toluene (7.2 percent), C9 to C10 alkyl benzenes (5.2 percent), isopropyl alcohol (5.1 percent), and a variety of other compounds.

1.4 Report Organization

This EE/CA is organized into nine major sections. Section 1 has presented the scope and objectives of this document as well as a brief Site background. Section 2 presents a Site description and a summary of Site characterization information. Section 3 describes the removal action scope and objectives. Removal action alternatives are described in Section 4 and evaluated independently in Section 4. Section 5 provides a relative evaluation of removal action alternatives and Section 6 then provides the rationale for selecting one of the alternatives as the recommended alternative. Section 7 provides a list of references that were used in preparation of the EE/CA, and figures and tables are presented in Sections 8 and 9, respectively.

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Section 2
Site Characterization Summary

2.1 Location and Climate

The former Omega property is located at 12504/12512 East Whittier Boulevard, Whittier, California (Figure 2-1). The climate of the area is characterized as semi-arid, with an average annual precipitation of approximately 16 inches. Precipitation occurs mainly during the winter and spring months.

2.2 Surface Topography

The property is relatively flat and is situated at an approximate elevation of 220 feet above mean sea level. Currently, two buildings (an office building and a warehouse) are located on the property, with concrete paving covering exterior areas. Review of historical aerial photos (USEPA, 2000) indicated that exterior areas were primarily unpaved until approximately 1972.

2.3 Surrounding Land Uses

One commercial property (Skateland) and two industrial properties (Medlin & Son and Terra Pave) are immediately adjacent to the former Omega property (southeastern, northwestern, and southwestern boundaries, respectively). The northeastern boundary of the property is bordered by Whittier Boulevard and a frontage road. The three commercial/industrial properties immediately adjacent to the property and nearby properties are discussed in the following sections.

2.3.1 Skateland

Skateland is located at 12520 Whittier Boulevard, adjacent to the southeastern boundary of the former Omega property. The Skateland facility consists of an indoor roller skating rink that is currently in operation and open to the public. Review of the aerial photographs indicates that the property was used for agricultural purposes in 1946. The building which presently occupies the property was observed on the 1956 photo. There were no documents or reports available for review regarding the Skateland property.

Indoor air samples were collected from the Skateland property on three separate occasions and analyzed for volatile organic compounds (VOCs). Ten samples were collected during May 2004 as part of the Omega Chemical On-Site Soils (OSS) Remedial Investigation/Feasibility Study (RI/FS). Eight samples were collected from the following interior locations: skating rink floor (duplicate sample also collected here), adjacent to the rear storage area, office, boy's restroom, kitchen, skate rental counter, and dance floor. Two exterior samples were also collected, one adjacent to the front door and one adjacent to the sewer manhole in the rear of the property.

Five samples were collected during December 2004, as follows: boy's restroom (including duplicate), girl's restroom, skating rink floor, and kitchen. In early-January

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2005, indoor air purifiers were installed at three interior locations: boy's restroom, girl's restroom, and kitchen. Samples were collected from these three areas on January 12, 2005, immediately prior to placing the purifiers in operation.

The following compounds were detected in the air samples: PCE (XX to XX µg/l), TCE (XX to XX µg/l),.....

2.3.2 Terra Pave

The Terra Pave, Inc. facility is located at 12511 East Putnam Street, adjacent to the southwestern boundary of the former Omega property. For information regarding historical activities at the Terra Pave property, a Phase 1 Environmental Site Assessment (ESA) Report prepared by Cardinal Environmental Consultants (Cardinal) on September 11, 1991, was reviewed.

The Phase I ESA Report was prepared for the New England Lead Burning Company (NELCO), which operated the site beginning in the mid-1950s. During the September 1991 site visit, the property was unoccupied. According to the report, NELCO purchased lead in sheets, pipe and solid rods and fabricated the desired product by burning (welding) the lead to the required shape. The welding was performed in the building located along the northeastern portion of the property (Building 2). The type of work performed in the remaining building (Building 1) was primarily carpentry work and did not involve lead welding. Building 1 is a two-story concrete-block structure that was also used for offices and warehousing. Building 1 is currently utilized by Terra Pave for office space. Building 2 and the small parking lot south of Building 1 are currently leased from Terra Pave and occupied by Madsen Roofing. Figure 4 from the Phase 1 ESA Report is provided in Appendix A.

NELCO utilized the exterior of the property for storage of equipment and loading materials or finished goods for shipment. The report noted that the undeveloped portions of the property consisted of exposed soil and miscellaneous rubble. Drainage patterns incised in the soil were observed trending in a southerly direction towards Putnam Street.

The report briefly discussed the findings of environmental investigations performed between 1989 and 1991 to evaluate the property for the presence of residual lead. To mitigate this concern, NELCO subcontracted Vector Three Environmental Inc. of Brea, California, to clean the interior of all facilities and remove superficial lead from the topsoil. Remedial activities were monitored by Cardinal staff and confirmatory dust wipe and soil samples confirmed that remaining lead levels were very low. The environmental reports and sampling results were not available for review; therefore; lead levels prior to and after remediation and the depth of the soils removal are unknown.

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2.3.3 Medlin & Son (Former Cal-Air)

The Medlin & Son (former Cal-Air facility) facility is located at 12484 Whittier Boulevard, adjacent to the northwestern boundary of the former Omega property. For

information regarding the former Cal-Air facility, a Phase I Environmental Assessment for the Evaluation of Potentially Hazardous Materials (Centec Engineering, Inc., August 5, 1997) was reviewed. The report was prepared for Maple Brothers Industrial, Inc. According to the report, a machine shop and office were constructed at the property in 1954, apparently by Roger Maples. The property was occupied by Accessory Products, Inc. until approximately early 1976. In September 1976, Cal-Air Conditioning Company added three new offices and occupied the property until 1996. The building on the property consists of a conglomeration of structural types, representing many additions and expansions during the years the property was occupied. A below-grade room and 'test tunnel' is reportedly located along the southern side of the building. According to a City Building Department document, the test tunnel was to be used for non-hazardous test work on government projects. At the time of the assessment, the property was unoccupied and access to the test tunnel access was blocked by a heavy metal door and a large amount of water in the vault of the front entrance.

In October 1987, four USTs used to contain gasoline and diesel fuels were removed from the property by Toxguard Systems, Inc. Laboratory analytical results indicated 72 ppm hydrocarbons in one of the soil samples collected from under the USTs, with no detectable hydrocarbon concentrations in the remaining seven samples submitted for analysis.

The property is currently occupied by Medlin & Son Engineering Services Inc. and is operated as a machine shop (screw machines, lathes and mills, tapping and threading, saw cutting, welding, etc.).

2.3.4 Nearby Properties

The Phase II Close Out Report (England & Associates and Hargis + Associates, Inc., 1996) provided information on four nearby properties located within an approximate one-half mile radius of the former Omega property. Fuel hydrocarbons (aromatic organics, total petroleum hydrocarbons, etc.) were detected in the groundwater underlying a former Chevron Station site located approximately 1,500 feet southwest (downgradient) of the Site. Fuel hydrocarbons were also detected in soil samples collected from a gasoline service station (G&M Oil Co.) located approximately 2,300 feet southeast (cross gradient) of the former Omega property. Naphthalene, trichloroethene (TCE), tetrachloroethene (PCE), and other hydrocarbons have been detected in soil and groundwater at a Leggett & Platt furniture manufacturing facility approximately 2,000 feet northwest (cross-gradient) of the property.

At a former automobile dealership (Jones Chevrolet) located 800 feet south of the former Omega property, a variety of contaminants [fuel hydrocarbons, chlorinated organics, Freons, methyl tertiary butyl ether (MTBE), aromatic organics, etc.] have been detected in groundwater underlying the property.

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2.4 Regional Geology and Hydrogeology

The Site is located in the Montebello Forebay area of the Central Groundwater Basin of the Coastal Plain of Los Angeles. The Montebello Forebay is an important area of groundwater recharge. Groundwater flow in the area is generally towards the southwest.

The Site is underlain by low permeability silty and clayey soils of the upper Pleistocene Lakewood Formation. The Lakewood Formation is locally derived from erosion of the Puente Hills to the northeast, and may be overlain by a thin cover of Holocene slopewash and alluvium that can be difficult to distinguish from the Lakewood Formation on the basis of lithology. Furthermore, local merging and interfingering of geologic units near the basin margin makes positive identification of individual geologic units encountered in borings problematic. The uppermost aquifer in the Site vicinity, probably the Gage aquifer in the lower portion of the Lakewood Formation, does not occur directly beneath the Site.

The nearest active downgradient water supply wells are located more than one mile from the Site. The closest active well (City of Santa Fe Springs well 30R3) is located on Dice Road by Burke Street, approximately 1.25 miles downgradient of the Site. According to the driller's log, this well is screened from 200 to 900 feet below ground surface (bgs) and at least two aquitards appear to be present between the shallowest aquifer and the top of the well screen.

2.5 Local Geology and Hydrogeology

This description of local geology and hydrogeology is based on an evaluation of lithologic logs from borings and wells advanced on-Site and downgradient of the Site. To date, the Omega PRP Organized Group (OPOG) has installed a total of 11 groundwater monitoring wells to investigate and characterize lithology and water quality in the Phase 1a and downgradient areas. Omega well and boring locations are illustrated on Figure 3-18 provided in Appendix A.

Lithologic data obtained from piezometers and wells installed along Putnam Street indicate that the uppermost aquifer in this area is comprised of sand, silty sand and well graded gravel containing significant silt. The aquifer is interbedded, and in the area between piezometers PZ1 and PZ2 contains a finer-grained interval separating the upper and lower portion of the aquifer. The deep well on Putnam Street (OW8b) indicates that a 26-foot thick clay separates the upper aquifer from the next deeper sandy interval that was screened in this well. This unit may correlate with the low permeability unit separating the Gage and Jefferson aquifers; however, the nearest regional cross-section in Bulletin 104 (State of California Department of Water Resources, 1961) suggests that this intervening unit is somewhat thicker.

A plan view location map and three detailed geologic cross-sections were included in the Revised Report Addendum for Additional Data Collection in the Phase 1a Area (CDM, 2005) as Figures 3-21 through 3-24. These four figures are provided in

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Appendix A. The three cross-sections were constructed approximately along the groundwater flow direction and orthogonal to this flow direction along Putnam Street. Cross-section A-A' (Appendix A, Figure 3-22) extends along an approximate groundwater flow line extending from OW7, upgradient of the Site, to OW4 downgradient of the Site. Shallow deposits in the vadose zone consist primarily of silt and clay deposits. This section illustrates the presence of the two aquifer zones present at the Site, separated by a low permeability confining zone. The upper aquifer zone appears to 'pinch out' in the area up gradient (east) of Putnam Street.

A relatively thick sand sequence is observed at OW4 and OW8 that thins dramatically at borings GP7 and GP1. This sandy zone is absent at boring GP2. The deeper sand zone is only observed at locations OW4 and OW8, which extended to a sufficient depth. Well OW1b extended to a similar depth; however, sandy lithologies were not encountered at this boring. Based on water levels at the OW4 and OW8 locations, where both deep and shallow zone completions are available, the groundwater elevations are significantly higher in the shallow aquifer. A similar downward gradient was observed at the cluster at OW1/1b. The varying water levels with depth indicate that a significant confining zone limits flow between these zones.

An additional cross-section, B – B', (Appendix A, Figure 3-23) was prepared extending from OW8b through H3, including wells OW1 and OW1b. This section also indicates that the upper zone pinches out. Well OW1b was drilled to approximately elevation 70 ft MSL and encountered only clayey lithologies. The interval in the sensing zone for this well does have small percentages of gravel interspersed in a clay matrix near the bottom of the well; however, the small percentage of coarser material is not expected to significantly increase the permeability of this unit. This is a similar elevation as the deeper aquifer encountered at OW8b, which is screened from elevation 75 to 85 ft MSL in a well sorted fine to medium sand. Well OW1b has a sensing zone that likely intersects the uppermost portion of the same interval intersected at OW8b, implying that this deeper zone pinches out in a manner similar to the upper aquifer zone, or, if the deeper aquifer is present, it occurs at a greater depth. USEPA is currently installing additional wells to define groundwater flow directions in the Site vicinity. If these additional wells indicate that well OW8b is downgradient of the Site, then no further investigation of the potential for a deeper aquifer zone at the Site is warranted, since OW8b does not indicate the presence of high levels of contamination.

An additional cross-section was constructed approximately along Putnam Street, at a right angle to the general flow direction. Cross-section C-C' (Appendix A, Figure 3-24) incorporates boring logs available in USEPA files for other sites. This section indicates that the shallow aquifer may pinch out to the north, since it was not encountered in borings north of H-7. The shallow aquifer configuration shows the presence of a lower permeability zone splitting the upper aquifer north of PZ1. Boring 4 indicates a thick sand sequence suggesting that the lower permeability split was eroded, or never deposited, resulting in good hydraulic connection within the upper aquifer at this location. The uppermost sand unit within the upper aquifer appears continuous

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below the water table elevation from H7 at the northern end to B3 at the southern end of the section. A clayey gravel is present at a similar depth in OW3 that is also part of this unit; however, the presence of the clay matrix is likely to diminish the hydraulic conductivity of the unit. The cross section shows a clay unit at OW3 overlying this clayey gravel interval. The sand thickness increases, and interbedded clays are absent at boring H11, near Washington Street. The presence of possible multiple channel units with intervening clays appears to have localized transport of the volatile organic compound (VOC) plume at the Site to the area centered around OW8.

Figure 3-25 (Appendix A) provides a three-dimensional view of the distribution of lithologies at the Site. A column representing each boring location is color-coded to indicate the relative permeability of lithologies encountered at each location. A three-tiered classification system was used on this figure, with the yellow zones indicating intervals with the highest relative hydraulic conductivity, orange indicating intermediate values and blue indicating intervals with the lowest relative hydraulic conductivity. The highest relative hydraulic conductivity class was assigned to deposits that consisted primarily of sand or gravel, with limited silt and clay content. The intermediate hydraulic conductivity class was assigned to lithologies that included primarily sand or gravel, but with significant silt or clay, which will lower the hydraulic conductivity. The lowest hydraulic conductivity class was assigned to intervals that were primarily silt or clay. This figure illustrates the limited extent of the upper aquifer east of Putnam near the presumed source area. Boring logs along Putnam Street and downgradient show significant high and intermediate hydraulic conductivity material is present that pinches out to the east of Putnam Street. The upper aquifer zone comprises a channel-like feature extending from near Putnam Street, toward the west. Information on the deeper aquifer is more limited, with only three wells extending to a sufficient depth. Based on this limited information, a similar trend occurs near the former Omega property east of Putnam Street, where sandy intervals are very limited.

Regional hydrogeologic information is inconclusive on the presence or absence of major regional named aquifers in this portion of the Whittier Area. A cross-section about 1.5 miles south of the Site is presented in Bulletin 104 (DWR, 1961) that suggests that the uppermost aquifers present are the Gage and Jefferson Aquifers. The upper aquifer at the Site may represent the Gage aquifer, while the lower aquifer is potentially the Jefferson aquifer.

2.6 Water Level and Groundwater Elevation Results

Water level measurements were collected and groundwater elevation contour maps were prepared for measurements collected monthly during May 2001 through April 2002, and semi-annually during April 2002 through August 2004. The most recent water level measurements were taken in February 2005. The direction of groundwater flow in the upper aquifer has been consistently towards the southwest during all 17 water level monitoring events (CDM, 2005). The groundwater elevation contour map for August 2004 (Figure 3-18) is provided in Appendix A. Insufficient water level data

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are available in the lower aquifer to define the groundwater flow direction. As directed by USEPA, OSVOG (Omega Small Volume Group) is currently proposing to install additional shallow and deep wells in the area downgradient of the Site. These wells will allow better definition of flow pathways in both the shallow and deeper aquifer zones.

Comment: Differs from how this acronym is defined on page 2-10

There is a noticeable change in hydraulic gradient in the vicinity of Washington Boulevard and the OW4 monitoring well cluster, which corresponds to the observed transition from finer-grained subsurface lithology in the area northeast of Washington Boulevard to coarser-grained subsurface lithology in the area southwest of Washington Boulevard. During the August 2004 sampling event, the hydraulic gradient upgradient of cluster well OW4 was approximately 0.01 ft/ft, and downgradient of cluster well OW4 it was approximately 0.003 ft/ft. A similar trend was observed during the August 2001 sampling event; with a hydraulic gradient of approximately 0.01 ft/ft up gradient of cluster well OW4 and 0.002 ft/ft downgradient of cluster well OW4.

As indicated by review of the hydrographs provided in Appendix G of the Revised Report Addendum, water levels have generally been declining throughout most of the monitored period (e.g., 74.19 feet bgs in well OW1 during May 2001 to 78.84 bgs during August 2004). During the monthly monitoring that occurred during mid-2001 to mid-2002, water levels were generally slightly higher during spring and summer months, and slightly lower during fall and winter months.

As observed at the three locations where shallow and deeper well pairs (OW1, OW4 and OW8) are present, groundwater elevations in the deeper wells were consistently deeper than the elevations observed at the shallow wells at those locations. Appendix G (CDM, 2005) presents each of these paired wells on the same figure to allow comparisons between the well pairs. Also, as water levels have dropped over time in wells OW1/ OW1b and OW4a/ OW4b, the differences in head between the monitored zones have increased at both locations. For example, at OW1/OW1b during May 2001, the head difference between the two zones was 3.43 feet. During the August 2004 sampling event, the head difference between the two wells was 9.28 feet. The well pair at OW4a/OW4b exhibited a similar trend, with a head difference of 3.76 feet in May 2001 and 8.99 feet in August 2004. The difference in head at location OW8/OW8b during August 2004 was 17.4 feet. The August 2004 sampling event was the initial sampling of newly-installed well OW8b. Subsequent sampling at OW8/OW8b will allow for additional evaluation of head differences at that location. The most recent measurements, taken in February, 2005, show an increase in water level in the deeper zone monitoring wells that decreased the head difference between the upper and lower aquifers. However, the vertical gradient remained downward.

This head difference suggests that significant hydraulic separation exists between the shallow and deeper screened zones. Although a downward gradient exists from the shallow zone to the deep formation, the water quality results from the three well pairs

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show that the hydraulic separation between the two zones limits downward vertical migration.

2.7 Aquifer Characteristics

Single borehole and multi-well aquifer tests were conducted by OPOG between 1999 and 2003. Estimates of transmissivity were obtained for the upper aquifer in wells along Putnam Street. The upper aquifer transmissivity in the Phase 1a area ranged from 563 to 810 ft^2/day. Transmissivity increased in the downgradient direction, with a value of nearly 2,700 ft^2/day estimated at OW4a. Design of a hydraulic containment system for the upper aquifer in the vicinity of Putnam Street will focus on the sand channel deposit that appears to be transmitting the majority of the contaminant mass from the Site.

2.8 Groundwater Sampling Results

Of the analytes tested in groundwater, chlorinated VOCs and 1,4-dioxane have been detected more frequently and at higher concentrations in the Phase 1a area; therefore, they are the primary compounds of concern. Tables summarizing groundwater analytical results for groundwater samples collected from Omega wells from 1996 to the present are provided in Appendix A.

Based on observations at three locations where a water table and deeper well pair are present (OW1/OW1b, OW4a/OW4b, and OW8/OW8b), chlorinated VOC concentrations were observed to decline with depth and appear to be of limited vertical extent. Concentrations were also observed to decline with increased distance downgradient from OU-1. Aromatic organics, semi-volatile organic compounds (SVOCs), pesticides, and metals were detected sporadically and at relatively low concentrations in groundwater samples collected from the Phase 1a area wells, therefore, they are not considered main compounds of concern.

As discussed previously, based on evaluation of the lithologic, aquifer testing, and groundwater sampling results, there appears to be a higher-permeability channel deposit immediately downgradient of the former Omega property in the vicinity of well OW8 on Putnam Street. Relatively higher (compared to well OW2 to the north and well OW3 to the south) VOC and 1,4-dioxane concentrations were also detected in this area. Samples from the current monitoring program and early Site investigations indicate that migration of chlorinated VOCs from OU-1 occurs primarily within the noted higher permeability deposits that extend from approximately the location of temporary probe H7 on the north to H11, near the intersection of Washington and Putnam. Based on observed concentrations, most contaminant mass is transmitted through the center of this feature, near the location of well OW8.

Groundwater sampling results indicate that the highest contaminant concentrations are associated with the former source area locations that are up gradient of Putnam Street, and that this contamination is predominantly limited to the shallower portions

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of the aquifer. These contaminants include various chloroethene parent compounds (PCE and TCE) and their primary daughter products (*cis*-1,2-DCE, *trans*-1,2-DCE, and vinyl chloride [VC]); chloroethane parent compounds (PCA, 1,1,1-TCA, and 1,1,2-TCA) and their daughter products (1,1-DCA, 1,2-DCA, and 1,1-DCE [abiotic hydrolysis of 1,1,1-TCA]); choromethanes [carbon tetrachloride (CTC), chloroform (CFM), and methylene chloride (MC)], 1,4-dioxane, and Freons. The compound 1,4-dioxane was also found at elevated concentrations at OU-1 at the location of boring GP3A.

The highest VOC concentrations are found within the shallow groundwater plume as evidenced by data from well OW1 (screened from 62.5 to 77.5 feet bgs) during the August 2004 semi-annual sampling event. In particular, the data indicate elevated concentrations of the parent-compounds PCE (150,000 μg/L) and 1,1,1-TCA (12,000 μg/L), with TCE (3,500 μg/L) and 1,1-DCE (2,000 μg/L) present at substantially lower concentrations and likely as biotransformation daughter-products, respectively. The concentration of PCE detected at monitoring well OW1 (150,000 μg/L) represents 75 percent of the aqueous solubility of PCE (200,000 μg/L) and therefore provides strong evidence for the presence of a dense non-aqueous phase liquid (DNAPL) within this area of the Site. Conversely, groundwater data from monitoring well OW1b (screened in a deeper interval from 110 to 120 feet bgs) during the August 2004 semi-annual sampling event indicate only minimal VOC detections at this deeper interval. For example, PCE was detected at a concentration of 87 μg/L, TCE at a concentration of 2.8 μg/L, and 1,1-DCE at a concentration of 2.2 μg/L.

1,4-dioxane was detected in Site well OW1 at concentrations ranging from 3,300 μg/L (February 2005) to 52,000 μg/L (February 2003). Concentrations in deeper well OW1b ranged from 15 μg/L (February 2005) to 60 μg/L (August 2002). Concentrations in Putnam Street well OW8 ranged from 98 μg/L (August 2003) to 6,900 μg/L (February 2005). 1,4-dioxane was not detected in recently-installed deeper well OW8b during sampling performed in August 2004 and February 2005.

Due to the significant depths at which water is first encountered at the Site (i.e., approximately 75 feet in the vicinity of OW1) and the predominance of fine-grained silts and clays in the subsurface, it is likely that a large fraction of any DNAPL release at the Site would be bound up in the unsaturated zone soils. Furthermore, groundwater data collected at OW1 indicate variability in PCE and TCE concentrations since 1996, which suggests that the VOC concentrations in groundwater are more likely to be controlled by leaching of contamination from the unsaturated zone (i.e., through DNAPL/water interactions and vapor/water interactions) rather than by dissolution from DNAPL within the saturated zone.

In 2001 and 2002, USEPA performed two phases of groundwater investigation in Operable Unit 2 (OU-2), the regional groundwater plume downgradient of OU-1. The investigation included cone penetration testing, collection of in-situ groundwater samples for laboratory analysis, and the installation and sampling of 18 groundwater

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monitoring wells (Weston Solutions, Inc., 2003). Figure 1 (CH2MHill, February 3, 2004), which illustrates the location of the former Omega property and the regional PCE plume (OU2), is provided in Appendix A. Additional groundwater investigations in the OU-2 area are currently being performed by the Omega Small Volume Generators Group (OSVOG) under USEPA oversight.

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2.9 Streamlined Risk Evaluation

The primary objective of the streamlined risk evaluation (SRE) is to assess existing and imminent risks to human health and the environment at the Site as they pertain to the contaminated groundwater in OU-1. At the Omega Site, risks from contaminated groundwater could theoretically result from use of groundwater for domestic or other purposes and from volatilization of groundwater contaminants into ambient and indoor air. A separate risk assessment evaluating risks associated with potential vapor intrusion will be provided in the On-Site Soils RI/FS. Therefore, this SRE does not address risks associated with this pathway, or with contaminated soils and soil gas. Because the Omega facility is located in an urban area that has been developed for decades, provides no suitable habitat, and contaminated subsurface soils are covered with buildings, asphalt, or concrete, ecological impacts from the contaminants in groundwater in OU-1 are not expected and are not evaluated in the SRE.

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The following documents and others cited within this section form the basis for the SRE:

- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A). Interim Final. EPA/5401/1-891002. December 1989.

2.9.1 Site Conceptual Exposure Model

The site conceptual exposure model is a description of potential exposure pathways associated with the site, including potential sources of contamination, transport mechanisms, exposure routes, and potentially exposed populations. Only exposure pathways likely to be complete and to contribute significantly to overall exposure are evaluated quantitatively in the SRE.

A complete exposure pathway would consist of the following four elements:

- A source and mechanism of release of chemicals to the environment
- A transport medium for the released chemical
- An exposure point (the point of potential contact between receptor and medium)
- An exposure route (e.g., inhalation, ingestion)

The site conceptual exposure model for the Omega Site is illustrated in Figure B-1. Potentially exposed populations are assumed to be an on-site industrial worker, an off-site industrial worker, an on-site construction worker, and an on-site recreational visitor. OPOG is not aware of any current plans for residential development at OU-1.

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2.9.1.1 Ingestion and Dermal Contact

Currently, groundwater within OU-1 (Gage aquifer) is not used for domestic, industrial, or agricultural purposes. Future use of groundwater for potable purposes is also unlikely due to high concentrations of TDS. However, the RWQCB's Basin Plan designates groundwater in the area as having the potential for beneficial use. Ingestion of shallow (e.g., Gage aquifer) groundwater will be considered a hypothetical but unlikely activity. No evidence suggests that contamination extends to any potable aquifer that underlies the Gage aquifer within OU-1. Because the Omega site is located within a recharge area for the Central Basin, if future data collection indicates that downward vertical migration has occurred, then future risk evaluations will need to address a potential drinking water pathway. A stepwise human health risk ratio evaluation is provided in Appendix B to provide additional information regarding potential health risk issues at the Site if groundwater is used for potable use in the future. Currently, this groundwater exposure pathway for ingestion is incomplete for all potential receptors.

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Groundwater is 70 feet below ground surface and construction workers are therefore not likely to encounter contaminated groundwater in their excavations. All exposure pathways for this receptor population are currently and will likely in the future be incomplete.

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2.9.1.2 Inhalation of Indoor Air – Volatilization during Groundwater Use

As noted above, groundwater within the contaminant area (Gage aquifer) is currently not used for any purpose nor is it likely to be used for potable use in the future due to high concentrations of TDS. As such, this groundwater exposure pathway is incomplete. However, given the RWQCB's designation of the area groundwater as having potential for beneficial use, future risk assessment will evaluate this hypothetical, albeit unlikely, exposure scenario.

2.9.1.3 Inhalation of Indoor Air - Soil Vapor

The Omega property and adjacent areas between the property and Putnam Street overly groundwater which is contaminated with VOCs. Theoretically, these COPCs could partition from groundwater via volatilization and migrate through subsurface soils and foundations and into indoor air. Recreational visitors and industrial workers could potentially be exposed through inhalation of soil vapors into indoor air. However, in order to completely evaluate the pathway for volatilization of groundwater contaminants and subsequent intrusion of vapors into indoor spaces, exposure to vadose zone soil gas should be evaluated. .Soil gas is recognized as the most appropriate medium for evaluation of vapor intrusion because it eliminates many of the uncertainties in estimating volatilization from groundwater into soil vapor. Therefore, this exposure pathway will be evaluated in the separate risk assessment to be prepared for the On-Site Soils RI/FS.

In addition, as will be discussed further in Section 3.1, the interim groundwater response action that is the focus of this report is intended as a migration control

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measure, to minimize the transport of VOCs in groundwater from OU-1 to downgradient areas. In parallel with this EE/CA, an On-Site soils RI/FS is being conducted, toward the selection and implementation of an appropriate remedy. A risk assessment is an integral component of that work, and the On-Site Soil RI/FS risk assessment will include an evaluation of exposure via vapor intrusion.

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2.9.1.4 Inhalation of Ambient Air

Volatile COPCs in the subsurface could migrate to the surface and be released to ambient air. Construction workers and on-site industrial workers who are outdoors could inhale these chemicals. However, because the atmosphere outside has no boundaries, any vapors that rise to surface and are released to ambient air will be quickly dispersed. Vapors migrating to indoor air are likely to present a more important exposure pathway for commercial/industrial workers because they will spend large amounts of time indoors, and because the building and foundation represent a 'trap' for migrating gases. Conclusions developed for indoor exposure to vapors should be protective of ambient exposure to vapors. Indoor air exposure will be evaluated in the separate risk assessment to be prepared for the On-Site Soils RI/FS.

2.9.2 Summary

No groundwater exposure pathways as they pertain to the EE/CA, are complete for the potential exposed populations. No current or foreseeable future risks are apparent due to existing contamination in the Gage aquifer. As additional information for the risk manager, Appendix B presents some hypothetical risk calculations that can be used to judge magnitude of impacts to the aquifer. As stated previously, a separate risk assessment of exposure to soil and soil gas will be prepared for the On-Site Soils RI/FS. Volatilization of groundwater contaminants and subsequent intrusion of vapors into indoor spaces will be evaluated with the exposure to soil gas.

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Section 3
Identification of Removal Action Scope and Objectives

3.1 Removal Action Scope and Objectives

In general terms, the scope of the non-time-critical removal action is to minimize migration of contaminated groundwater beyond OU-1. The scope therefore covers only OU-1 groundwater and groundwater migrating from OU1 and recognizes that additional remedial actions are likely to be taken to address OU-1 soils contamination as part of the on-Site soils RI/FS. Additionally, groundwater downgradient of Putnam Street will be addressed by EPA's OU2 RI/FS.

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The specific Removal Action Objectives (RAOs) for this EE/CA are:

1. Provide horizontal and vertical containment within the Phase 1a Area of groundwater contamination associated with the Omega property

2. Meet air emission and water treatment standards associated with the treatment, disposal, and/or reuse of extracted groundwater.

Though not specifically a RAO, operation of a groundwater extraction and treatment system will also result in the removal of contaminant mass from the groundwater in the Phase 1a Area.

With regard to the implementation schedule for the selected removal action, the design of the selected removal action will begin after the following components of the EE/CA process are completed:

- Public comment on the EE/CA and EPA's Proposed Plan (at least a 30-day period)

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- EPA preparation of the Action Memorandum, including a response to public comments

3.2 Potential Applicable or Relevant and Appropriate Requirements

This evaluation identifies potential Applicable or Relevant and Appropriate Requirements (ARARs) pertinent to the identification, screening and selection of removal action alternatives for OU-1. Other criteria or guidelines to be considered (TBCs) in selecting an appropriate action are also identified.

3.2.1 Definition of ARARs and Other Criteria or Guidelines to be Considered (TBCs)

Section 121(d) of CERCLA requires that removal actions at CERCLA sites attain (or justify the waiver of) any federal or state environmental standards, requirements,

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criteria, or limitations that are determined to be legally applicable or relevant and appropriate. Federal ARARs may include requirements under any of the federal environmental laws (e.g., the Clean Air Act – 42 U.S.C., Section 7401, et seq. [CAA], the Clean Water Act – 33 U.S.C. 1251, et seq. [CWA], and the Safe Drinking Water Act – 42 U.S.C. Section 300f, et seq., National Primary Drinking Water Regulation, 40CFR Part 414 [SDWA]). State ARARs may only include promulgated, enforceable environmental or facility-siting laws that are more stringent or broader in scope that federal requirements. Many California state laws give enforcement authority to local agencies which develop regulations that implement state requirements. As a result, some local regulations can also be ARARs.

An ARAR may be either 'applicable,' or 'relevant and appropriate,' but not both. If there is no specific federal or state ARAR for a particular chemical or remedial action, or if the existing ARARS are not considered sufficiently protective, then other criteria or guidelines to be considered (TBCs) may be identified and used to ensure the protection of public health and the environment. According to the NCP (40 CFR part 300), 'applicable,' 'relevant and appropriate,' and 'to be considered' are defined as follows:

- Applicable requirements are those cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

- Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not 'applicable' to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be relevant and appropriate. In some circumstances, a requirement may be relevant but not appropriate for the site-specific situation and thus not considered as an ARAR.

- TBCs consist of advisories, criteria, or guidance developed by EPA, other federal agencies, or states that may be useful in developing CERCLA remedies. The TBC values and guidelines may be used as EPA deems appropriate.

In determining whether a requirement is applicable or relevant and appropriate, EPA considers the remedial actions contemplated, the hazardous substances present, the characteristic of the hazardous substances, the physical characteristics of the site, and other appropriate factors.

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Pursuant to CERCLA §121 and the NCP, only substantive requirements are ARARs. In addition, under CERCLA §121(e) and the NCP (40 CFR Part 300.68(a)(3)), federal, state, and local permits are not required for those portions of a CERCLA cleanup that are conducted entirely onsite, as long as the actions are selected and carried out in compliance with CERCLA §121.

3.2.2 Identification of ARARs

ARARs may be placed into three categories:

- Chemical-specific
- Location-specific
- Action-specific

Chemical-specific ARARs are health- or risk-based concentration limits, numerical values, or methodologies for various environmental media (i.e., groundwater, surface water, air, and soil) that are established for a specific chemical that may be present in a specific media at the site, or that may be discharged to the site during remedial activities. These ARARs set limits on concentrations of specific hazardous substances, pollutants, and contaminants in the environment.

Location-specific requirements set restrictions on certain types of activities based on site characteristics. Federal and state location-specific ARARs are restrictions placed on the concentration of a contaminant or the activities to be conducted because they are in a specific location. Examples of specific locations possibly requiring ARARs may include floodplains, wetlands, historic places, and sensitive ecosystems or habitats.

Action-specific requirements are technology- or activity-based requirements that are triggered by the type of remedial activities under consideration. Examples are RCRA regulations for waste treatment, storage, or disposal.

The following groups of ARARs and TBCs were considered during the identification process:

- Federal, California, and local requirements (applicable, relevant and appropriate, or to be considered)
- Federal and California criteria, advisories, and guidance documents (to be considered)

The ARARs identified below are those that potentially may apply to the remedial action, and should be considered to be potential ARARs. A final determination of ARARs, including rationale, specific regulations, and citations, will be made when the alternative is selected in EPA's Action Memorandum.

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3.2.3 Potential Chemical-Specific ARARs

A removal action for the Omega site has not yet been selected. As a result, all chemical-specific ARARs identified in this section are preliminary. The chemical-specific ARARs established for the Non-Time Critical Removal Action will be used as a performance standard applicable to the removal action alternatives proposed by this document. However, these chemical-specific ARARs may change or new chemical-specific ARARs may be identified in the future in any Records of Decision for the Omega Site. Since the removal action selected for the OU-1 groundwater at the Omega Site will be an interim action, chemical-specific requirements discussed below may not be ARARs for the purpose of establishing final cleanup levels throughout the aquifer (see 55 Fed. Reg. 8755).

The contaminants of potential concern (COPCs) for the Omega Site are those contaminants identified in the groundwater underlying the Site. A tabular summary of Omega Site COPCs is provided in Appendix B. Table B-2 (found in Appendix B) lists all chemicals detected in Phase 1a area wells (OU1), lists USEPA and CalEPA Maximum Contaminant Levels (MCLs), and asterisks all detected compounds which exceed MCLs. Table B-4 summarizes COPCs and indicates which compounds exceed Federal and State MCLs. The chemical-specific federal and state ARARs that address the contaminants of potential concern are discussed below.

3.2.3.1 Federal Safe Drinking Water Act

EPA has established MCLs (40 CFR Part 141) under the SDWA to protect public health from contaminants that may be found in drinking water sources. MCLs are enforceable standards that are applicable at the tap for water that is delivered directly to 25 or more people or to 15 or more service connections. MCLs are potentially applicable to groundwater that is treated and served as drinking water. MCLs are potentially relevant and appropriate to any water that is discharged into the environment and to in-situ groundwater at or beyond the edge of a containment area (CERCLA Compliance With Other Laws Manual [OSWER Dir. 9234.1-01, Aug. 1988]).

Under the SDWA, EPA has also designated Maximum Contaminant Level Goals (MCLGs) (40 CFR Part 141) which are health-based goals that may be more stringent than MCLs. MCLGs are based entirely on health considerations and do not take cost or feasibility into account. MCLGs are set at levels, including an adequate margin of safety, where no known or anticipated adverse health effects would occur. MCLGs are not applicable or relevant and appropriate because the MCLGs for the contaminants of concern at the Omega site are either zero (40 CFR Section 300.430(e)), or are equal to the MCLs.

The SDWA also prohibits injection which endangers an underground source of drinking water. Federal Underground Injection Control (UIC) Regulations (40 CFR 144.12 and 144.13) would apply if re-injection of extracted and treated groundwater were part of the selected alternative.

Comment: This sentence is the same as the first sentence in 3.2.2

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Comment: A removal action doesn't "establish" ARARs

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3.2.3.2 California Safe Drinking Water Act

California has established standards for sources of public drinking water, under the California Safe Drinking Water Acts of 1976 and 1996 (Health and Safety Code (H&SC) §§ 4010.1, 4026(c), and 116365). Some state MCLs are more stringent than the corresponding federal MCLs. In these instances, the more stringent MCLs would take precedence. There are also some chemicals that lack federal MCLs. Where state MCLs exist, they may also be ARARs for these chemicals. MCLs are potentially applicable to groundwater that is treated and served as drinking water.

3.2.3.3 Water Quality Control Plan for Los Angeles Region

The Los Angeles plan (commonly referred to as the 'Basin Plan') designates the beneficial uses of groundwater in the Los Angeles coastal plain to be municipal and domestic, agricultural, industrial service, and industrial process supplies (California Water Code §13240 et seq.). The Basin Plan establishes beneficial uses of ground and surface waters, establishes water quality objectives, including narrative and numerical standards, establishes implementation plans to meet water quality objectives (WQOs) and protect beneficial uses, and incorporates statewide water quality control plans and policies. The WQOs for groundwater are based on the primary MCLs. Any activity that may affect water quality must not result in the water quality exceeding the WQOs. The Basin Plan is also discussed as a location-specific ARAR in Section 3.2.5.2.

3.2.4 Potential Location-Specific ARARs

Federal and state location-specific ARARs are restraints placed on the concentration of a contaminant or the activities to be conducted because they are in a specific location. Examples of location-specific ARARs are requirements restricting actions in, or otherwise protecting, floodplains, wetlands, historic places, and sensitive ecosystems or habitats. Location-specific ARARs are really a subset of action-specific ARARs, in that they do not drive the need for a CERCLA action to occur, but, if CERCLA action is otherwise appropriate, may constrain the range of appropriate action.

3.2.4.1 National Historic Preservation Act

This statute and implementing regulations (16 U.S.C. § 470, 40 CFR Part 6.310(b), 36 CFR Part 800),require federal agencies or federal projects to take into account the effect of any federally-assisted undertaking or licensing on any district, site, building, structure, or object that is included in, or eligible for, the Register of Historic Places. If a response action is likely to have an adverse effect on any cultural resources which are on or near the Site, EPA should examine whether feasible alternatives exist that would avoid such effects. If effects cannot reasonably be avoided, measures should be implemented to minimize or mitigate the potential effect.

The National Historic Preservation Act (NHPA) regulations reserve formal determination of eligibility for the National Register of Historic Places and 'no adverse effects' determinations for federal agencies. Based on the absence of any

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known cultural resources within the OU-1 area that are covered by this Act, the NHPA will likely not be determined to be an ARAR for any of the alternatives evaluated in this EE/CA.

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3.2.4.2 Archaeological and Historic Preservation Act

This statute and implementing regulations (16 U.S.C. § 469, 40 CFR Part 6.301(c)) establish requirements for the evaluation and preservation of historical and archaeological data that may be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program. As there are no known historical or archaeological data that could be destroyed by implementing one of alternatives, this Act will likely not be determined to be an ARAR when the alternative is selected.

3.2.4.3 Historic Sites, Buildings, and Antiquities Act

This statute (16 U.S.C. §§ 461-467, 40 CFR Part 6.301(a)) requires federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks. Removal alternatives contemplated for groundwater contamination within OU-1 at the Omega site are not anticipated to affect any of the facilities regulated under the above act, and therefore this Act will likely not be determined to be an ARAR when the alternative is selected.

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3.2.4.4 Location Standards for TSD Facilities

California Code of Regulations, Title 22, Section 66264.18 establishes location standards for Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDFs). These standards may be applicable to groundwater extraction and treatment facilities. Subsection 66264.18(a) prohibits the placement of TSDFs within 200 feet of a fault displaced during the Holocene epoch. Subsection 66264.18 (b) requires TSDFs located within a 100-year floodplain be capable of withstanding a 100-year flood.

3.2.4.5 Endangered Species Act

This statute and implementing regulations (15 U.S.C. §§1531-1544, 50 CFR Part 402, 40 CFR Part 6.302(h)) require that any federal activity or federally authorized activity may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify the critical habitat of a listed species. Compliance with this requirement involves consultation between EPA and the U.S. Fish and Wildlife Service, resulting in a determination as to whether there are listed or proposed species or critical habitats present at or near the Omega Site and, if so, whether any proposed activities will impact such wildlife or habitat. As no endangered species have currently been identified at the Omega Site, this Act will likely not be determined to be an ARAR when the alternative is selected.

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3.2.4.6 California Fish and Game Code

California Fish and Game Code Sections 2080, 5650(a) (b) and (f), 12015, and 12016 prohibit the discharge of harmful quantities of hazardous materials into places that may deleteriously affect fish, wildlife, or plant life. These sections may be applicable if

the selected removal action provides for the discharge of extracted and treated groundwater to a surface water body. Section 3503 prohibits the taking, possession, or needless destruction of any bird nests and eggs, except as provided by the Fish and Game Code or regulations.

3.2.5 Potential Action-Specific ARARs

Action-specific ARARs are usually technology- or activity-based requirements for remedial activities. Action specific ARARs described in this section are intended to address those actions resulting from implementation of remedial alternatives. Remedial alternatives for the Omega site could require the construction and operation of groundwater extraction facilities, groundwater treatment facilities (e.g., air stripping with off-gas control), and pipelines and other conveyance facilities needed to deliver treated water to an industrial water supply system, municipal wastewater collection and treatment system, surface water drainage system, or spreading basin. A brief description of potential action-specific ARARs is presented below.

3.2.5.1 Local Air Quality Management

One potential VOC treatment technology is air stripping. Air emissions from air strippers are regulated by the California Air Resources Board, which implements the federal CAA as well as the California H&SC (Section 39000, et seq.) through local air quality management districts. Local districts can add additional regulations to address local air emission concerns. The local air district for the Site is the South Coast Air Quality Management District (SCAQMD). The SCAQMD has adopted several rules that may be ARARs for air stripper emissions.

SCAQMD Regulation XIII, comprising Rules 1301 through 1313, establishes new source review requirements. Rule 1303 requires that all new sources of air pollution in the district use best available control technology (BACT) and meet appropriate offset requirements. Emissions offsets are required for all new sources that emit in excess of one pound per day.

SCAQMD Regulation XIV, consisting of Rule 1401 requires that best available control technology for toxics (T-BACT) be employed for new stationary operating equipment, so that the cumulative carcinogenic impact from air toxics does not exceed the maximum individual cancer risk limit of 10 in 1 million (1×10^{-5}). Many of the contaminants found in the Omega site groundwater are air toxics subject to Rule 1401.

SCAQMD Rules 401 through 405 may also be ARARs. SCAQMD Rule 401 limits visible emissions from a point source; Rule 402 prohibits discharge of material that is odorous or causes injury, nuisance, or annoyance to the public; Rule 403 limits fugitive dust; Rule 404 limits particulate matter in excess of concentration standard conditions; and Rule 405 limits solid particulate matter including lead and lead compounds.

These regulations would only be applicable if the groundwater treatment technology is modified in the design phase to include air stripping.

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3.2.5.2 Federal Clean Water Act and California Porter-Cologne Water Quality Act

California's Porter-Cologne Water Quality Act (California Water Code, Div. 7) incorporates the requirements of the federal Clean Water Act (CWA) and implements additional standards and requirements for surface and groundwaters of the state. This Act gives authority to the Los Angeles Regional Water Quality Control Board (RWQCB) to formulate and adopt a water quality control plan for its region; the RWQCB has adopted the Los Angeles Region Water Quality Control Plan (Basin Plan). The Basin Plan identifies the beneficial uses of surface and groundwaters in specific watersheds and water quality objectives necessary to protect these beneficial uses.

The RWQCB regulates discharges to surface and groundwaters through the issuance of National Pollutant Discharge Elimination System (NPDES) permits, issued pursuant to CWA requirements, Waste Discharge Requirements (WDR), or Water Reclamation Requirements (WRR) for treated wastewater.

In issuing a WDR or WRR, the RWQCB considers the beneficial uses and water quality objectives for the affected water body as well as existing water quality data and mixing and dilutionary effects. Consequently, the Basin Plan's water quality objectives for receiving water bodies may be ARARs if the selected removal action provides for the discharge of extracted groundwater.

The Basin Plan also incorporates the State Water Resources Control Board (SWRCB) policy 'Statement of Policy with Respect to Maintaining High Water Quality in California' (Resolution 68-16). Resolution 68-16 requires that existing water quality be maintained unless it is demonstrated that a change will benefit the people of California, will not unreasonably affect present or potential uses, and will not result in water quality less than prescribed by other State policies. Any activity that may increase the volume or concentration of a waste discharged to surface or groundwater is required to use 'best practical treatment or control.' Resolution 68-16 may be applicable if the selected removal action provides for the discharge of extracted groundwater to a surface water body or reinjection of groundwater. Resolution 68-16 has also commonly been applied to the migration of existing groundwater contamination plumes.

The EPA Region IX Regional Administrator's decision in the matters of George Air Force Base and Mather Air Force Base (July 9, 1993) sets forth a balancing process to be used on a case-by-case basis to determine re-injection standards for treated groundwater under Resolution 68-16. This process requires that the following three factors be balanced in order to determine the permitted discharge level: (1) site-specific considerations, including the hydrogeologic conditions at the site, the quality of the receiving water and the designated uses of the receiving water; (2) treatment technologies; and (3) cost.'

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The Basin Plan also incorporates the SWRCB's 'Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304' (Resolution Number 92-49). Subsection III.G of Resolution 92-49 requires attainment of background water quality or, if background levels cannot be restored, the best quality of water that is reasonable. To determine an above-background standard, Water Code Chapter 15 Section 2550.4 should be applied, which requires a finding that background is technologically or economically infeasible to achieve. Case-by-case alternative cleanup levels for the restoration of water quality must, at a minimum:

- Be consistent with maximum benefit to the people of the state
- Not unreasonably affect present and anticipated beneficial use of the waters
- Not result in water quality less than that prescribed in the Basin Plan and policies adopted by the SWRCB and RWQCB

As an exception to the Subsection III.G requirements, Subsection III.H of Resolution 92-49 provides for 'containment zones'. A containment zone is defined as a specific portion of a water bearing unit where the lead agency finds it is unreasonable to remediate to the level that achieves water quality objectives. The discharger is required to take all actions necessary to prevent the migration of pollutants beyond the boundaries of the containment zone in concentrations which exceed water quality objectives. The discharger must verify containment with an approved monitoring program and must provide reasonable mitigation measures to compensate for any significant adverse environmental impacts attributable to the discharge. Although Subsection III.H may waive the water quality requirements of Subsection III.G within the containment zone, it does not waive federal ARARs, including MCLs, as relevant and appropriate for drinking water aquifers

Resolution 92-49 may be relevant and appropriate to the Omega site groundwater.

3.2.5.3 SWRCB Resolution No. 88-63

This policy, Sources of Drinking Water SWRCB Resolution No. 88-63, specifies that ground and surface waters of the state are either existing or potential sources of municipal and domestic supply except water supplies with:

- Total dissolved solids exceeding 3,000 milligrams per liter, or
- Natural or anthropogenic contamination (unrelated to a specific pollution incident) that cannot reasonably be treated for domestic use using either best management practices (BMPs) or best economically achievable treatment practices, or
- The water source does not provide a sustained yield of 200 gallons per day.

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The designation is applicable to the Omega Site because groundwater underlying the Site does not fall into one of the exceptions listed above. Therefore, groundwater under the Site is a potential source of drinking water.

3.2.5.4 California Code of Regulations 27 CCR §§ 20380, 20400, 20410, and 20415

These regulations require corrective action monitoring to demonstrate completion of the selected remedy for the Site. Corrective action measures may be terminated when all COC concentrations are reduced below their respective concentration limits throughout the entire zone affected by the release. Section 20410 requires monitoring for compliance with remedial action objectives for three years from the date of achieving cleanup standards.

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3.2.5.5 California Hazardous Waste Management Program

The federal Resource Conservation and Recovery Act (RCRA) establishes requirements for the management and disposal of hazardous wastes. In lieu of the federal RCRA program, the State of California is authorized to enforce the Hazardous Waste Control Act (H&SC, Div. 20, Chapter 6.5), and implementing regulations (California Code of Regulations (CCR) Title 22, Division 4.5), subject to the authority retained by EPA in accordance with the Hazardous and Solid Waste Amendments of 1984 (HSWA). California is responsible for permitting treatment, storage and disposal facilities within its borders and carrying out other aspects of the RCRA program. Some of the Title 22 regulations may be ARARs if the selected removal action for the Omega site results in the generation or disposal of hazardous wastes.

Comment: Add a citation for the HSWA.

Hazardous Waste Generator Requirements

CCR Title 22 establishes requirements applicable to generators of hazardous waste. Implementation of certain potential removal action alternatives may generate hazardous waste as a result of groundwater monitoring and well installation (e.g., contaminated soil and groundwater and used personal protective equipment). Alternatives involving groundwater treatment may also generate hazardous waste as a result of groundwater treatment to remove VOCs (e.g., spent carbon). These requirements may be applicable to a removal action at the Omega site.

Land Disposal Restrictions

CCR Title 22 Section 66268 defines hazardous waste that cannot be disposed of to land without treatment. Land Disposal Restrictions may be applicable to the disposal of spent carbon generated during the treatment of groundwater for removal of VOCs and the disposal of residuals associated with groundwater monitoring and well installation (e.g., contaminated soil and groundwater, used personal protective equipment). Water treated to MCLs does not trigger land disposal restrictions.

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3.2.5.6 Clean Water Act and CSDLAC Wastewater Ordinance

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Under 40 CFR Part 403, standards are set to control the introduction of pollutants to publicly-owned treatment works (POTWs). These standards are implemented by the local POTW, which is the County Sanitation Districts of Los Angeles County (CSDLAC) for the Omega site.

In addition to the general standards and requirements of the CWA, the CSDLAC Wastewater Ordinance specifies additional limitations, standards, and requirements for the discharge of wastewater. Fees for sewer connections and wastewater concentration and flow may also be applicable.

Finally, the CSDLAC has a policy of only accepting groundwater as a last resort. This policy is contained in Section 305 of the CSDLAC Wastewater Ordinance (July 1, 1998) and in 'Guidelines for the Discharge of Rainwater, Storm Water, Groundwater, and Other Water Discharges.' This Ordinance provides that no person can discharge or cause to be discharged, groundwater into any sewerage facility which directly or indirectly discharges to facilities owned by the District, except where prior approval for such discharge of water is given by the CSDLAC through wastewater discharge permits. The district recommends that groundwater either be reused or discharged to the storm drain system. However, in recognition that there may be situations where sewer discharge may be the only viable disposal alternative, the CSDLAC may accept the discharge of groundwater on a case-by-case basis, after all other alternatives have been determined to be unfeasible. The Wastewater Ordinance is applicable for Alternatives 1 and 2 at the Omega Site.

The CSDLAC has also established effluent limitations for accepting groundwater discharges (listed in 'Documentation To Be Provided To Pursue The Discharge Of Groundwater To The Sanitation District's Sewerage System'). These limits are as follows:

- pH greater than 6
- Dissolved sulfides less than 0.1 mg/L
- TDS less than 1,000 mg/L if discharged to a water reclamation plant (if the concentrate from a membrane separation process were discharged to an interceptor line leading to the Carson Treatment Plant, no TDS limitation would apply)
- ASTM closed cup flash point greater than 60°C
- Total VOCs and SVOCs less than 1.0 mg/L (per EPA Methods 601 & 602 or 624 & 625)
- Cyanide (Total) less than 10 mg/L
- Arsenic less than 3 mg/L
- Cadmium less than 15 mg/L

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- Chromium (Total) less than 10 mg/ L
- Copper less than 15 mg/L
- Lead less than 40 mg/L
- Mercury less than 2 mg/L
- Nickel less than 12 mg/L
- Silver less than 5 mg/L
- Zinc less than 25 mg/L

Additionally, the District's Wastewater Ordinance Section 406 contains a comprehensive list of prohibited wastes which can not be discharged to the District's sewerage facilities. These effluent limitations and discharge prohibitions under the Wastewater Ordinance are applicable as ARARs at the Omega Site

3.2.5.7 California Hazardous Waste Control Law

Hazardous waste transport offsite for treatment or disposal must obtain and use a hazardous waste manifest and comply with Department of Transportation regulations (22 CCR, Div. 4.5, Chapter 12).

3.3 Identification of Guidance and Criteria to be Considered (TBCs)

Other standards, criteria, or guidance to be considered are federal, state, or local advisories or guidance that do not have the status of potential ARARs. If there are no specific federal or state ARARs for a particular chemical or removal action, or if the existing ARARs are not considered sufficiently protective, then guidance or advisory criteria may be identified and used to ensure the protection of public health and the environment. TBCs may provide health effects information, technical information on performing or evaluating site investigations or remedial actions, and useful policies for dealing with hazardous substances.

3.3.1 State Action Levels (ALs) and Public Health Goals (PHGs)

The state has also developed numerical criteria as state action levels (ALs) for selected chemicals in drinking water for which MCLs have not yet been established. Since early 1989, numerous state ALs have been promulgated as state MCLs. The ALs referred to here are those that have never been promulgated and thus, are not ARARs.

Although drinking water ALs are not specifically listed in laws or regulations, they are derived under general protection of the public in the California Safe Drinking Water Act and the California Porter-Cologne Water Quality Act.

Although not directly legally applicable to surface water discharge, drinking water ALs are used by the RWQCB as action-specific, non-promulgated limits for organic contaminants in wastewater discharge. The RWQCB frequently specifies in NPDES permits that groundwater treatment system discharges must meet ALs if wastewater is discharged to a storm drain or flood channel. NPDES permits are required by the

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federal CWA for certain offsite wastewater discharges and, although a permit is not required for an onsite CERCLA response action, onsite discharge should comply with substantive discharge criteria. Discharge criteria are usually based on the Basin Plan, treatment technology limitations, and case-by-case conditions. The RWQCB incorporates ALs as part of its case-by-case conditions.

Similarly, the Office of Environmental Health Hazard Assessment (OEHHA), in accordance with the H&SC, Section 116365 (California Safe Drinking Water Act of 1996), has adopted Public Health Goals (PHGs) for approximately 46 chemicals. PHGs represent non-mandatory goals based solely on public health considerations and are developed based on best available data in the scientific literature. These documents provide technical assistance to the Department of Health Services for establishing primary drinking water standards (MCLs) which also consider economic factors and technical feasibility.

3.3.2 Chemical-Specific TBCs

Health Advisories, Drinking Water Exposure Limits (DWELs), California Action Levels (CALs), Region 9 Preliminary Remediation Goals (PRGs), and California PHGs are potential TBCs for the Omega site. EPA's Office of Drinking Water has developed TBC guidance through their Health Effects Advisories (HEAs) for chemicals that may provide the best available standard for a particular chemical for which no enforceable standard exists. HEAs describe nonpromulgated concentrations of drinking water contaminants at which adverse health effects would not be anticipated to occur over specific exposure durations. HEAs serve as guidance and are not legally enforceable standards. HEAs are developed for 1-day, 10-day, longer term (approximately 7 years), and lifetime exposures, based on noncarcinogenic endpoints of toxicity. HEAs are published in EPA guidance documents. HEAs for certain organic chemicals are listed in EPA's Health Advisories for 25 Organics (March 1987). HEAs are also listed in EPA's *2004 Edition of the Drinking Water Standards and Health Advisories* (Winter 2004). EPA identifies HEAs for more chemicals than those that have MCLs. In most cases where a chemical has both an MCL and a HEA, the MCL is more stringent. For a few chemicals, the HEAs are more stringent than the MCLs – bromodichloromethane, dibromochloromethane, barium, chloramines, and chlorine. If EPA determines that MCLs are not protective, the HEAs may be TBCs.

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3.3.3 California Well Standards

The California Department of Water Resources document *California Well Standards Bulletin Nos. 74-81 and 74-90* includes construction standards (e.g., casing specifications, annular sealing materials, etc.) for the installation of extraction and monitoring wells. The construction standards should be considered for extraction and monitoring well installations.

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3.4 Other Requirements or Policies

3.4.1 RCRA Manifest Requirements

The preamble to the NCP clarifies that when noncontiguous facilities are treated as one site, activities at the aggregated site, as explained above, must comply with (or waive) substantive requirements of federal or state environmental laws that are ARARs. In addition, the preamble explains that 'even where noncontiguous facilities are treated as one site, movement of hazardous waste from one facility to another will be subject to RCRA manifest requirements' (55 Fed. Reg. 8666, 8691). Because the Omega Site potentially encompasses contiguous and/or non-contiguous facilities, hazardous waste generator requirements, including manifest requirements, may be an ARAR.

3.4.2 Offsite Policy

The Procedures for Planning and Implementing Offsite Response Actions (40 CFR Part 300.440) describes the procedures that should be observed when a CERCLA response action involves the offsite storage, treatment, or disposal of CERCLA wastes. The purpose of the offsite policy is to avoid having CERCLA waste contribute to present or future environmental problems by directing these wastes to facilities determined to be environmentally sound.

3.4.3 Water Rights

Water rights in the Central Basin are adjudicated in a court of law. This adjudication results in assigning water rights to numerous parties that each hold rights to greater than one percent of the natural safe yield of the basin, and additional parties that each hold rights to less than one percent of the natural safe yield.

The judgment also establishes the duties of a Watermaster which include: annually determining an operating safe yield for the basin; monitoring pumpers' compliance with the judgment; issuing permits for all new and increased pumping in the basin; and preparing an annual report that includes details of pumping activities in the basin. The amount of groundwater that each water rights holder can pump in any year is adjusted by prorating the pumper's prescriptive rights (percentage of natural safe yield) by the operating safe yield, as established by the Watermaster.

The majority of the groundwater pumped from the Central Basin is used for drinking water, supplied to the public by purveyors that are regulated as public water supply systems. Annual pumping may equal or exceed the operating safe yield of the basin. When excess extraction occurs, pumpers are assessed for the cost of importing water to replenish the excess amount extracted pursuant to this judgment.

For groundwater cleanup projects, the fee requirement for replenishment water may be waived depending on factors such as the end use of the treated groundwater and results of negotiations or agreements with the Watermaster and parties that have water rights. If the treated groundwater is discharged to surface water which is used for recharge at a downstream location, the replenishment fee could be waived and the

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discharger would be required to pay only an administrative fee to the Watermaster. If the treated groundwater is discharged to the sewer or treated to drinking water standards and sold to a water purveyor, replenishment water fees may be applicable.

3.5 ARAR Waivers

ARARs can be waived in certain circumstances. The six general waivers stated in CERCLA §121(d) are paraphrased below:

1. The remedial action is an interim measure and is part of a final remedy that will attain the waived ARAR upon completion.

2. Compliance with ARARs will result in greater risk to human health and the environment than other options that do not comply with ARARs.

3. Compliance with ARARs is technically impracticable from an engineering perspective.

4. The remedial action will not meet ARARs, but will attain an equivalent standard of performance through use of another method or approach.

5. The state has not consistently applied a state ARAR or demonstrated the intent to apply the ARAR to similar remedial action sites.

6. Superfund money spent at a site will not provide a balance between the need to protect human health and the environment and the availability of Superfund money for response actions at other facilities.

As appropriate, future reports will document the justification for the waiver of any ARARs.

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Section 4
Identification and Evaluation of Removal Action Alternatives

The purpose of this section is to develop removal action alternatives based on technologies that are applicable to Site conditions and to evaluate these alternatives independently. The alternatives are then evaluated relative to each other in Section 5. The evaluation of the alternatives is performed in general accordance with the guidelines provided in the USEPA document titled 'Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA' (USEPA, August 1993). In addition, portions of the U.S. EPA Guidance for Conducting Remedial Investigations and Feasibility Studies (RI/FS) Under CERCLA (USEPA, October 1988) are also used as appropriate.

4.1 Identification of Removal Alternatives

For the purposes of this EE/CA, three removal action alternatives have been evaluated. These are described below.

4.1.1 Alternative 1: Source Area Contaminant Mass Removal from Groundwater

This alternative provides for groundwater extraction wells in the suspected source area where contaminant concentrations are the highest to maximize removal of contaminant mass. A treatment system would treat extracted groundwater which would then be discharged to surface water/storm drain or sanitary sewer.

Extraction Wells

The hydrogeology of the OU-1 upper aquifer limits the amount of groundwater that can be extracted. The upper aquifer in the source area consists of relatively low permeability silt and clay materials, with possible thin interbeds of more permeable material. Information concerning OU-1 soil permeabilities and strata distributions has been used to conceptually design the well locations and spacing for this alternative. As shown in Figure 4-1, 14 wells would be installed for groundwater extraction on the southwestern border of the former Omega property. It is anticipated that each well would extract an average flow of approximately 0.3 gpm for a total of approximately 5 gpm. These estimates would be evaluated in the field during design, as appropriate. Operations would be conducted on a pulsed basis to maximize mass removal due to the steep cone of depression that will develop around individual wells in this low permeability material. Three new monitoring wells are shown on Figure 4-1 that would be used to collect water level measurements to confirm the capture zone of the extraction wells operating together. The basis for the conceptual design for this alternative is given in Appendix D.

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Groundwater Treatment

A conceptual design of a groundwater treatment system has been developed for the purpose of evaluating the cost of this and the other two alternatives (i.e., all alternatives require treatment of extracted groundwater with the same contaminants at different concentrations). The effluent quality for the treatment systems of all three alternatives has been conservatively assumed to be the same – the California Maximum Contaminant Levels (MCLs) for VOCs and the Action Level for 1,4-dioxane (3 μg/L); however, the actual discharge requirements will be determined during the design of the selected alternative and may be different from this assumption. For example, it is recognized that the NPDES discharge limits for some VOCs may be lower than their California MCLs.

For the purpose of evaluating the cost it is assumed that a combination of advanced oxidation process (AOP) which uses hydrogen peroxide and ozone (for 1,4-dioxane and several VOCs) followed by liquid phase granular activated carbon (for other VOCs and Freons) can provide effective treatment of Site contaminants. For costing purposes, the GAC vessels have been sized according to the anticipated flow and carbon usage rate. Depending upon the amount of residual H_2O_2 in the treated water and its disposition, the need for catalytic carbon for removal of H_2O_2 to acceptable levels may have to be considered, especially if surface water is discharged under NPDES requirements. This issue will be addressed during the early stages of the project permitting phase.

Also for costing purposes, it has been assumed that the treatment system would be located within OU-1; however, the actual location of the system will be determined during the design phase and may be different and may be located off the former Omega property (e.g., on the Skateland property).

A treatability study would be performed to confirm that an AOP system followed by activated carbon polishing will meet the discharge requirements. Specifically, the study will evaluate the ability of the AOP system to completely oxidize Site contaminants such as Freons, 1,4-dioxane and chlorinated ethenes and will also evaluate the ability of activated carbon to remove contaminants that are not readily oxidized such as chlorinated ethanes. Results of the study will be used to modify the assumed treatment processes if necessary and to provide a technical basis for the design of the groundwater treatment system.

Items that make up the treatment component of all alternatives include:

- Submersible pumps with associated control systems installed in 4-inch extraction wells screened in the upper aquifer
- Sub-grade piping to transfer water from extractions wells to the treatment system
- A treatment building

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- An equilibration tank
- An AOP unit that includes hydrogen peroxide and ozone tanks
- Two activated carbon vessels piped in series
- Sub-grade discharge piping
- Three monitoring wells to confirm containment

Specifics for Alternative 1 include:

- 14 vertical extraction wells installed to a depth of approximately 100 feet
- 14 1/3 horsepower (hp) submersible pumps with 0.3 - 7 gpm capacity
- A 10-gpm maximum capacity AOP unit
- Two carbon vessels each holding 250 pounds of carbon

Treated Water Discharge

Following treatment, it is assumed that groundwater extracted using this alternative would be discharged under a National Pollutant Discharge Elimination System (NDPES) permit to a storm drain or sanitary sewer. Storm drains in the vicinity of the former Omega property flow to the Sorensen Avenue Drain, which is located approximately one mile to the southwest. A sub-grade pipe would be installed to convey the treated water from the treatment building to the surface discharge point. During the design of the interim remedy, the potential for re-injection of the treated groundwater in lieu of surface discharge may be evaluated. Re-injection would only be considered if (a) the currently anticipated permeability limitations can be overcome, and (b) there is value with respect to recharging the groundwater.

4.1.2 Alternative 2: Putnam Street Hydraulic Containment for Groundwater

This alternative includes groundwater extraction wells along Putnam Street. Pumping from these wells would contain the plume and minimize further migration of contaminants beyond Putnam Street. Extracted groundwater would be treated by a treatment system located on or adjacent to OU-1. After treatment, extracted groundwater would be discharged to surface water/storm drain or sanitary sewer. The basis for the conceptual design for this alternative is given in Appendix D.

Extraction Wells

Downgradient of OU-1 near Putnam Street, the higher permeability layer of soils that underlie at least a portion of OU-1 becomes thicker and therefore wells in this layer are capable of producing more water compared to the wells described in Alternative

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Comment: Meaning that there is really no value in reinjection? If that's true, then why even pursue it? Either clarify the rationale for why it makes sense to consider reinjection, or drop it from discussion under alternatives 1 & 2.

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1. The geometry of the sandy interval will impact the capture zone that would develop under this alternative. Analytical groundwater modeling has been used to provide the basis for a conceptual design for a hydraulic containment system near Putnam Street. This modeling approach assumes that the higher permeability deposits found beneath Putnam Street are present beneath the entire OU-1, (and vicinity), which results in a higher estimated pumping rate. The limited areal extent of the permeable units will in fact decrease the rate of extracted water needed to maintain capture. As shown in Figure 4-2, five wells would be located on the east side of the street and their anticipated capture zones would cover the width of the contaminant plume in this area. Modeling indicates that a total extraction rate of 28 gpm would be sufficient to provide the appropriate capture. Three new monitoring wells are shown on Figure 4-2 that would be used to collect water level measurements to confirm the capture zone of the extraction wells operating together.

Comment: "continue to OU-1" doesn't make any sense-do you mean "continue to the former Omega property?"

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Groundwater Treatment

The groundwater treatment system for this alternative would include those items that were listed in Section 4.3.1 for all alternatives. Specifics for Alternative 2 include:

- Five vertical groundwater extraction wells installed to a depth of approximately 100 feet
- Five 1/3 hp submersible pumps with 0.3 - 7 gpm capacity
- Three new monitoring wells for plume containment verification
- A 35-gpm maximum capacity AOP unit
- Two carbon vessels each holding 500 pounds of carbon

For costing purposes, the GAC vessels have been sized according to the anticipated flow and carbon usage rate.

Treated Water Discharge

As described for Alternative 1, following treatment, it is assumed that the extracted groundwater would be discharged under a NDPES permit to surface water or storm drain or sanitary sewer. A sub-grade pipe would be installed to convey the treated water from the treatment building to the discharge point. As with Alternative 1, during the design of the remedy, the potential for re-injection of the treated groundwater in lieu of surface discharge may be evaluated. Re-injection would only be considered if (a) the currently anticipated permeability limitations can be overcome, and (b) there is value with respect to recharging the groundwater.

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Comment: See comment above regarding injection

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4.1.3 Alternative 3: Putnam Street Hydraulic Containment for Groundwater with Re-injection for Enhanced Anaerobic Biodegradation

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This alternative is similar to Alternative 2, with the exception that a portion of the treated groundwater would be mixed with amendments and re-injected in the source area to stimulate enhanced anaerobic biodegradation (EAB) (Figure 4-3) and expedite the removal of groundwater contaminants in the source area. The basis for the conceptual design for this alternative is given in Appendix D.

Re-injection of treated groundwater downgradient of Putnam Street was considered, but ranked lower than re-injection on the former Omega property because (1) use of EAB in this area would remediate only a very small portion of the downgradient plume, and (2) downgradient re-injection may accelerate contaminant transport by increasing groundwater flow velocities and changing flow pathways in the vicinity of the re-injection points.

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Groundwater Treatment

The groundwater treatment system for this alternative would include those items that were listed in Section 4.3.1 for all alternatives. Specifics for Alternative 3 include:

- Five vertical groundwater extraction wells installed to a depth of approximately 100 feet
- Five 1/3 hp submersible pumps with 0.3 - 7 gpm capacity
- Three new monitoring wells for plume containment verification (Figure 4-3)
- Three new monitoring wells for EAB performance monitoring (Figure 4-3)
- A 35-gpm capacity AOP unit
- Two carbon vessels each holding 500 pounds of carbon

For costing purposes, the GAC vessels have been sized according to the anticipated flow and carbon usage rate.

EAB

The objective of the EAB component of this alternative is to enhance contaminant removal in the source area by modifying the groundwater conditions to stimulate the anaerobic biodegradation. This can be achieved by amending the treated groundwater with an electron donor, and re-injecting it on OU-1. A more detailed description of this remedial technology is provided in Appendix E.

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The primary chlorinated VOCs detected in samples from OW1 (a well on the former Omega property) are PCE, 1,1,1-TCA, TCE, Freon 113, Freon 11, 1,1-DCE, 1,2-DCA,

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and chloroform. EAB can reduce the contaminant mass in the source area for each of these compounds. Conceptually, the EAB portion of this alternative would consist of the following components:

- A mixing tank where the treatment system effluent is mixed with sodium lactate (an electron donor)
- A chemical pump to transfer lactate from a drum to the mixing tank
- An injection trench
- A transfer pump to convey amended water from the mixing tank through sub-grade piping to the injection trench
- A control panel to allow for programmed re-injection on a pulsed basis

A feature of the OU-1 subsurface that will significantly impact the implementation of EAB is the lack of sufficient higher permeability soils at OU-1-that would be targeted for re-injection. Consequently, only a limited amount of amended water could be re-injected at OU-1. Groundwater modeling (Appendix D) suggests that only approximately half of the groundwater extracted at Putnam Street (28 gpm) could be re-injected at OU-1. Compared with vertical injection wells, an injection trench would improve the ability to inject into the thin, higher permeability layer(s) at OU-1. A trench has a higher probability of intersecting the thin discontinuous zones that are capable of transmitting water compared to vertical wells. Injection into the trench would result in a groundwater mound that would locally increase the vertical gradient between the upper and lower aquifer zones. However, the groundwater near the trench would be enhanced with electron donor, so no downward spreading of the contaminant plume is anticipated.

To evaluate the cost, it has been assumed that an injection trench would be used for implementing EAB in this alternative. The results of additional Site characterization sampling that will be performed as part of the On-Site Soils RI/FS Work Plan Addendum No. 2 (CDM, July 8, 2005) will be used during the design phase to verify if an injection trench is the most effective means for applying EAB amendment. If appropriate, the depth and horizontal dimensions and location of an injection trench would be determined during the design phase; however, for cost estimating purposes a depth of 75 feet has been assumed along with the location shown in Figure 4-3.

Typically, EAB performance is enhanced when the amendment solution is provided on a pulsed basis. For the purpose of costing this alternative, it is assumed that half of the treated groundwater (14 gpm) will be amended and re-injected half of the time and discharged to surface water or sanitary sewer the other half. Therefore, the re-

Comment: Below you say that half of the flow would be reinjected half of the time (i.e., one quarter of the total flow). Resolve the inconsistency.

Comment: If I understand this line of reasoning, the groundwater mound is going to push water downward, and what would prevent downward spreading of contaminants is the actual anaerobic degradation before those contaminants move deeper (not just the fact that there's a lot of electron donor present in the water). I'm not convinced that the absolute certainty of their statement is supported by the realities of the situation.

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Comment: Given that we are no where near selecting a soil remedy, this deleted sentence about combined benefits is purely speculative and not appropriate to include in the EE/CA.

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injection assumption combined with the pulse frequency result in an average EAB flow of approximately 7 gpm on an annual basis. Based on CDM experience with EAB systems, we have assumed a target sodium lactate concentration for the feed solution of 3,000 mg/L. Therefore, to evaluate cost it is assumed that an average of approximately 250 pounds of sodium lactate would be used per day. Bench-scale and/or pilot scale testing would be conducted to verify the applicability of EAB and to provide a design basis for the EAB system.

EAB performance would be monitored by collecting groundwater samples from seven monitoring wells (including three new wells shown on Figure 4-3) on a quarterly basis. The samples would be analyzed for VOCs, sulfate, ferrous iron and dissolved organic carbon.

4.2 Evaluation Criteria

The following evaluation criteria have been used to analyze the three removal action alternatives described above for the purpose of identifying a preferred removal action:

1) Effectiveness

   a) Overall protection of human health and the environment

   b) Compliance with ARARs

   c) Long-term effectiveness and permanence

   d) Reduction of toxicity, mobility, or volume through treatment

   e) Short-term effectiveness

2) Implementability

3) Cost

Each of the above criteria is described below:

- Overall Protection of Human Health and the Environment -- This criterion determines whether the alternatives can adequately protect human health and the environment, in both the short-term and long-term, from unacceptable risks posed by contaminants present at the Site by eliminating, reducing, or controlling exposures to levels which would meet the removal action objectives. This criterion is based on a composite of other factors assessed under the evaluation criteria, especially, long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs, which are described below. It addresses specifically how each removal action alternative achieves protection over time, and how site risks are reduced.

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- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) - This criterion evaluates how each alternative complies with ARARs identified for the Site in Section 3.2. Evaluation of alternatives by this criterion relies on action-specific ARARs for the removal action alternative based on the technologies used to meet the removal action.

- Long-term Effectiveness and Permanence -- This evaluation criterion addresses the results of a removal action in terms of the risk remaining at the Site after removal action objectives have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes within the scope of the removal action. The following components of this criterion are considered for each alternative:

  - Magnitude of remaining risk after cleanup
  - Adequacy of controls
  - Reliability of controls

- Short-Term Effectiveness -- This evaluation criterion addresses effects of the removal action during the construction and implementation phase until the removal action objectives are met. Under this criterion, alternatives are evaluated with respect to their effects on human health and the environment during implementation of the removal action. The following factors of this criterion are considered for each alternative:

  - Protection of community health during the removal actions
  - Protection of workers' health during the removal actions
  - Time until removal action objectives are achieved
  - Environmental impacts (adverse impacts to the environment as a result of removal activity and reliability of mitigation measures in preventing or reducing the potential impacts)

- Reduction of Toxicity, Mobility, or Volume -- This evaluation criterion addresses the effectiveness of the removal action in reducing the toxicity, mobility, or the volume of hazardous substances left at a site. This criterion is satisfied when treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of the total volume of contaminated media. The following factors of this criterion are considered for each alternative:

  - The treatment or recycling processes to be used, and materials to be treated

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- The amount of hazardous materials to be treated or recycled
- The estimated degree of expected reduction in toxicity, mobility, or volume
- The degree to which the treatment is irreversible
- The type and quantity of treatment residuals expected to remain after treatment
- Whether the alternative satisfies the preference for treatment

■ Implementability -- The implementability criterion addresses the technical and administrative feasibility of implementing a removal action alternative and the availability of various services and materials required during its implementation. This criterion involves analysis of the following factors:

- Technical feasibility, with regards to feasibility of construction and operation of the alternative, adaptation of the alternative to the environmental conditions at the site, the reliability of the technologies composing the alternative, the ease of undertaking additional removal action (if any), and the ability to monitor the effectiveness of the remedy.
- Administrative feasibility, such as operating permits/approvals, ability to implement institutional controls, etc.
- Availability of services and materials, including the availability of personnel and technology; off-site treatment, storage and disposal capacity and services; and availability of necessary services, equipment, materials and specialists.

■ Cost -- The cost criterion evaluates removal action alternatives based on economic considerations, which primarily consist of cost estimates derived for each alternative. The cost estimates are usually composed of capital cost and annual (O&M) cost. The costs for each alternative are estimates and their accuracy may be within a -30 percent to +50 percent of the final project cost.

The estimates of capital cost for each alternative consists of direct (construction) and indirect (non-construction and overhead) cost. Direct cost includes expenditures for the equipment, labor, and materials necessary to perform removal actions. Capital cost for each removal alternative was derived from literature sources, vendor quotes, and previous studies. Indirect costs include engineering expenses such as engineering design, construction supervision, permit and related expenses, contingency allowances, and other services that are not part of the actual removal activities but are required to complete the removal action.

Annual costs (O&M costs) are the costs necessary to ensure the continued effectiveness of the removal action. Annual costs include operating labor costs,

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maintenance expenses, auxiliary materials and utilities, disposal of any residuals, and monitoring/support costs.

4.3 Evaluation of Alternatives

The evaluation criteria described above have been used to evaluate each alternative independently (i.e., not relative to each other – this is done in Section 5).

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4.3.1 Alternative 1: Source Area Contaminant Removal From Groundwater

Effectiveness

Overall protection of human health and the environment

This alternative is protective of human health and the environment in that contaminant mass is removed from OU-1 groundwater, thereby limiting migration of contaminants to downgradient areas. However, because extraction wells are placed to maximize contaminant removal from the source area (and not overall contaminant capture within the OU-1 area), continued, but limited, migration of contaminants to downgradient areas would continue.

Compliance with ARARs

This alternative would comply with ARARs, in particular the action-specific ARARs that apply to construction and operation of the groundwater treatment system. Specifically, the extracted groundwater would be treated to the standards established in a NPDES permit that would be issued in accordance with the objective set forth in the Basin Plan (see Section 3.2).

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Long-term effectiveness and permanence

While significant contaminant mass would be removed from OU-1 groundwater under this alternative, some contaminant mass would remain at OU-1 largely due low permeability soils that limit contaminant mass removal. Also, treatment of the groundwater would produce residuals in the form of spent activated carbon; however, the spent carbon would be transported to an off-Site regeneration facility and the associated risk would be very low.

Reduction of toxicity, mobility, or volume through treatment

This alternative results in the removal of contaminants from OU-1 groundwater via destruction (AOP unit) and transfer to another medium (activated carbon). The groundwater extraction and treatment process would also, over time, result in the reduction in the volume of contaminated groundwater.

Short-term effectiveness

There would be an increase in short-term risk associated with construction of the extraction wells, piping and groundwater treatment system. However, these risks are typically mitigated by using common construction safety procedures and construction oversight. RAOs may not be met after groundwater extraction begins because capture of the entire plume within the OU-1 area may not be achieved.

Comment: I deleted the sentence about mobility because it's reduction isn't achieved via treatment per se (compared to something like in situ reducation of CrVI to CrIII).

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Implementability

This alternative is considered technically feasible in that it utilizes treatment units that are proven and easily constructed using standard construction practices. A treatability study would be conducted to verify that an AOP system followed by activated carbon treatment would be sufficient to meet all discharge requirements. Some administrative tasks include obtaining a NPDES permit for surface discharge of treated groundwater and access agreements for installation of extraction wells on private property and construction of the treatment system and the discharge piping.

Cost

Cost estimates have been performed for each of the removal action alternatives based on a conceptual level design of each alternative. The costs were estimated at a feasibility study level of +50 percent to -30 percent. The cost estimates for Alternative 1 are as follows:

Capital Costs: $3,539,000
Annual Costs: $329,000
Total Present Worth Cost: $7,622,000

Major costing assumptions:

- Treatment of extracted groundwater can be achieved to the necessary levels using an AOP system followed by activated carbon polishing.
- The average flow of extracted groundwater is 5 gpm.
- 14 vertical extraction wells would be installed to a depth of approximately 100 feet
- The system would operate for a period of 30 years
- The discount rate is 7 percent

4.3.2 Alternative 2: Putnam Street Hydraulic Containment For Groundwater

Effectiveness

Overall protection of human health and the environment
This alternative is protective of human health and the environment in that the highly contaminated groundwater within OU-1 is controlled and prevented from migration to areas downgradient of OU-1. This alternative also contributes to long-term protection of human health by removing contaminant mass from groundwater.

Compliance with ARARs
This alternative would comply with ARARs, in particular the action-specific ARARs that apply to construction and operation of the groundwater treatment system.

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Specifically, the treated water would be treated to the standards established in a NPDES permit, which would be prepared in accordance with the objective set forth in the Basin Plan (see Section 3.2).

Long-term effectiveness and permanence

The groundwater extraction system would enhance contaminant mass removal from the groundwater within OU-1 and would reduce contaminant concentrations there. It is expected that some contaminant mass would remain in OU-1 groundwater largely due to the low permeability of the materials in the source area. Like Alternative 1, this alternative would produce treatment residuals in the form of spent activated carbon. The spent carbon would be transported to an off-Site regeneration facility and the associated risk would be very low.

Reduction of toxicity, mobility, or volume through treatment

Using this alternative, chlorinated ethenes and 1,4-dioxane would be removed from the extracted groundwater by destruction (AOP unit) and other contaminants would be transferred to another medium (activated carbon). The groundwater extraction and treatment process would also, over time, result in the reduction in the volume of contaminated groundwater.

Short-term effectiveness

There would be an increase in short-term risk due to implementation of this alternative associated with construction of the extraction wells, piping and the groundwater treatment system. Unlike Alternative 1, construction activities would be conducted in public rights-of-way to install extraction wells and sub-grade piping. However, these risks are easily mitigated through use of common construction safety procedures and construction oversight. RAOs would be met soon after groundwater extraction begins when hydraulic containment is established.

Implementability

This alternative is technically feasible because utilizes treatment units that are proven and easily constructed using standard construction practices. A treatability study would be conducted to verify that an AOP system followed by activated carbon treatment would be sufficient to meet all discharge requirements. Some administrative tasks include obtaining a NPDES permit for surface discharge of treated groundwater and obtaining access for construction of the extraction and monitoring wells and sub-grade piping, including those in public rights-of-way.

Cost

The cost estimate for Alternative 2 is as follows:

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Capital Costs: $2,773,000
Annual Costs: $296,000
Total Present Worth Cost: $6,447,000

Major costing assumptions:

- Treatment of extracted groundwater can be achieved to the necessary levels using an AOP system followed by activated carbon polishing.
- The average extraction flow necessary to maintain hydraulic containment of the plume is 28 gpm.
- Five vertical extraction wells would be installed to a depth of approximately 100 feet
- The system would operate for a period of 30 years
- The discount rate is 7 percent

4.3.3 Alternative 3: Putnam Street Hydraulic Containment For Groundwater, with Re-injection for Enhanced Anaerobic Biodegradation

Effectiveness

Overall protection of human health and the environment
This alternative is protective of human health and the environment in that contaminant mass is removed from groundwater using two concurrent technologies: groundwater extraction at Putnam Street and EAB by re-injection at the former Omega property. The use of EAB will increase the rate of mass removal from OU-1 low permeability materials. Therefore, this alternative is expected to expedite the mass removal rate. Further the dual action of the hydraulic containment and the EAB would minimize the migration of contaminants downgradient of OU-1. This alternative also contributes to long-term protection of human health by removing contaminant mass from groundwater.

Compliance with ARARs
This alternative would comply with ARARs, in particular the action-specific ARARs that apply to construction and operation of the groundwater treatment system and for the EAB. Specifically, the treated water would meet the standards established in a NPDES permit prepared in accordance with the objective set forth in the Basin Plan (see Section 3.2). Re-injected groundwater would also be treated to the appropriate levels according to ARARs related to re-injection for the purpose of in situ treatment.

Long-term effectiveness and permanence
While significant contaminant mass would be removed from groundwater under this alternative, some contaminant mass is expected to remain at OU-1 largely due to

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diffusion limited transport of contaminants from within lower permeability soils in the source area. Like Alternatives 1 and 2, this alternative would produce treatment residuals in the form of spent activated carbon. The spent carbon would be transported to an off-Site regeneration facility and the associate risk would be very low.

Reduction of toxicity, mobility, or volume through treatment

This alternative results in the removal of certain contaminants from groundwater via destruction (AOP unit), transfer of others to another medium (carbon), and *in situ* degradation of contaminants via EAB. In addition, the in situ EAB would minimize the migration of contaminants.

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Short-term effectiveness

There would be an increase in short-term risk due to implementation of this alternative associated with construction of the extraction wells, piping, re-injection trench, and the groundwater treatment system. Unlike Alternative 1, construction activities would be required in public rights-of-way to install the extraction wells and the sub-grade piping. However, these risks are easily mitigated through use of common construction safety procedures and construction oversight. RAOs would begin to be met soon after groundwater extraction and EAB begin when hydraulic containment is established.

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Implementability

This alternative is technically feasible because it utilizes treatment units that are proven and easily constructed using standard construction practices. A treatability study would be conducted to verify that an AOP system and subsequent activated carbon treatment would be sufficient to meet all discharge requirements. Installation of the re-injection trench would require relatively specialized equipment – an excavator capable of reaching approximately 75 feet bgs. However, this equipment is available and this part of the alternative would be constructed at the former Omega property, thereby avoiding potential impacts to activities in public rights-of-way. Other than the re-injection component, the EAB element of this alternative does not pose significant implementability issues. This technology has been successfully implemented across the country for similar applications. Bench- and/or pilot-scale testing would be performed to verify the effectiveness of EAB for Site conditions.

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Some administrative tasks include obtaining a NPDES permit for surface discharge and for re-injection of treated groundwater and addressing access issues for construction of the extraction and monitoring wells, the sub-grade piping, and the re-injection trench.

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Cost

The cost estimate for Alternative 3 is as follows:

Capital Costs: $4,325,000

Annual Costs: $482,000
Total Present Worth Cost: $9,432,000

Major costing assumptions:

- The AOP system followed by activated carbon polishing would meet discharge requirements
- The average extraction flow necessary to maintain hydraulic containment of the plume within OU-1 is 28 gpm
- The re-injection trench will be built to a depth of 75 bgs and a length of approximately 100 feet
- Half of the excavated soils during trench construction will be disposed off-Site as non-hazardous waste and half will be disposed of off-Site as hazardous (analytical results will determine the actual classifications)
- The average re-injection rate for EAB is 7 gpm
- The average sodium lactate use rate is 250 pounds per day
- The system would operate for a period of 20 years
- The discount rate is 7 percent

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Comment: What justifies shutting the system off after 20 years? Are you saying there would be no more contaminated groundwater that could migrate beyond OU-1?

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Section 5
Comparative Analysis of Removal Action Alternatives

This section compares the *relative* performance of the alternatives regarding the evaluation criteria and forms the basis for recommending one of the alternatives.

5.1 Effectiveness

Overall protection of human health and the environment

Of the three alternatives, Alternative 3 provides the highest overall protection of human health and the environment. Alternative 3 increases mass removal rate by the *coupled effect of the groundwater extraction system at* Putnam Street and the EAB.

Comment: Do they have any idea of how much EAB will increase the rate of mass removal? Is there enough certainty to know that it's significant?

Using the same reasoning, Alternative 2 would be protective of both human health and the environment because it minimizes further downgradient transport of contaminants beyond Putnam Street while also removing contaminant mass from the groundwater. Alternative 1 would be least protective as it would not fully capture all contaminated groundwater between the property boundary and Putnam Street.

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Compliance with ARARs

All three alternatives rate similarly with respect to this criterion. Alternatives 1 and 2 are very similar in this regard, as ARARs are mainly associated with the treatment of groundwater. Alternative 3 has additional ARARs associated with re-injection to enhance *in situ* treatment; however, no problems are anticipated in complying with these additional ARARs.

Long-term effectiveness and permanence

Using the same reasoning provided under the overall protection criterion, of the three alternatives, Alternative 3 would result in the smallest residual contaminant mass. Alternative 1 may have a higher *initial* mass removal rate, but it allows remaining mass to migrate downgradient of OU-1. Alternative 3 would have the highest overall mass removal rate. Alternative 2 may remove less contaminant mass than Alternative 1, but provides better containment of the plume than Alternative 1 and minimizes migration of the plume downgradient of Putnam Street.

All three alternatives would produce treatment residuals in the form of spent activated carbon. In all three cases, the carbon would be transported and regenerated off-Site, therefore the risk associated with this residual waste would be similar, differing only in the amount of spent carbon generated. The amount of spent carbon generated would be proportional to the VOC concentrations and the amount of groundwater treated; therefore Alternatives 2 and 3 (28 gpm) would produce similar amounts that would be greater than that for Alternative 1 (~5 gpm).

Comment: Isn't it proportional to the mass of contaminants in the GW treated, not just the volume?

Comment: Are you talking about total amounts over the 20 or 30 years or the rate at which those amounts are produced?

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Reduction of toxicity, mobility, or volume through treatment

All three alternatives incorporate treatment of Site contaminants via *ex situ* groundwater treatment using AOP and activated carbon. Alternative 3 has the highest degree of reduction of toxicity, mobility or volume trough treatment because it incorporates *ex situ* treatment of groundwater, *in situ* treatment of groundwater (EAB) and hydraulic containment to reduce contaminant mobility. Alternative 2 has the next highest reduction since it combines ex situ groundwater treatment with hydraulic containment.

Short-term effectiveness

All three alternatives include construction work and the associated short-term environmental impacts; however, in all cases these impacts are readily mitigated using standard construction safety protocols. Alternative 3 has a lower short-term effectiveness rating in that it includes installation of a re-injection trench that would require disposal of a significant volume of contaminated soil. However, this removal of soils coupled with the *in situ* treatment of groundwater via EAB would result in a higher degree of long-term effectiveness for this alternative.

5.2 Implementability

Technical Feasibility

All three alternatives have similar components that have similar degrees of technical feasibility. Specifically, the groundwater extraction and treatment elements of the alternatives are proven technologies with many examples of successful implementations at sites with similar conditions. A treatability study will be performed to verify that that the treatment processes will meet discharge requirements. The EAB component reduces the rating of Alternative 3 for this criterion relative to the other alternatives because of the installation of the 75-foot re-injection trench, the uncertainty of injection rate into this trench, and the challenge of delivering the EAB amendments to the targeted area of the aquifer.

Administrative Feasibility

The re-injection/EAB component reduces the rating of Alternative 3 for this criterion lower relative to the other two alternatives. An injection permit would be required and monitoring would need to be performed to comply with this permit and there may be significant administrative issues associated with disposing of the soils excavated during trench installation. Second, re-injection onsite under Alternative 3 is likely to have greater challenges than the disposal to Alternatives 1 and 2. In addition, the installation of the injection trench may significantly impact business operations at Star City Automotive. However, these additional administrative requirements are not anticipated to impede the implementation of this alternative.

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5.3 Cost

Table 5-1 shows a summary of the cost estimates for the three removal action alternatives. Alternative 2 rates the highest for this criterion (lowest cost), followed by Alternative 1 and Alternative 3.

For the present worth calculation it has been assumed that Alternatives 1 and 2 would operate for 30 years, while the EAB component of Alternative 3 would allow a shorter operation period of 20 years. There is significant uncertainty associated with estimating long-term cleanup times; however, it is probable that the additional mass removal associated with EAB in Alternative 3 would result in a decrease in operational time of the containment system. A 20-year operation period was selected to reflect this estimated reduction in cleanup time in Alternative 3 when compared to Alternatives 1 or 2.

Comment: It seems that, given the RAO of preventing migration beyond OU-1, the only basis for using a 20-yr period of operation for #3 is if the contaminants are all gone at the end of that period or would naturally attenuate before reaching the OU-1 boundary.

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Section 6
Recommendation of Removal Action Alternative

This section gives the rationale for selecting the recommended removal action alternative.

Table 6-1 presents a summary of the evaluation of removal action alternatives using the criteria described in Sections 4 and 5.

Compared to Alternative 1, Alternatives 2 and 3 have significantly higher ratings for reduction of contaminant mobility and overall protection of human health and the environment due to their ability to provide superior contaminant migration control downgradient of OU-1. Additionally, Alternative 3 provides greater contaminant mass destruction via treatment when compared to Alternatives 1 and 2.

Although contaminant mass removal is not a RAO, Alternative 3 offers additional benefits by reducing contaminant mass up gradient of the containment system. However, Alternative 3 rates significantly lower for some other evaluation criteria (e.g., higher cost and lower short term effectiveness due to risks and access issues associated with construction of the injection trench) because of implementation issues regarding re-injection of treated groundwater for EAB. Since the additional implementation issues and higher cost associated with Alternative 3 are not off set by the additional benefits it provides, Alternative 2 is the recommended alternative.

It is currently anticipated that the 30 percent design of the removal action will be submitted to the EPA for review in the fall of 2005. It is further anticipated that startup of the removal action (i.e., completion of its construction) will occur in the 2nd quarter of 2006.

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Section 8
Figures

Figure 1-1 Site Location Map

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Figure 1-2 Phase 1a Area

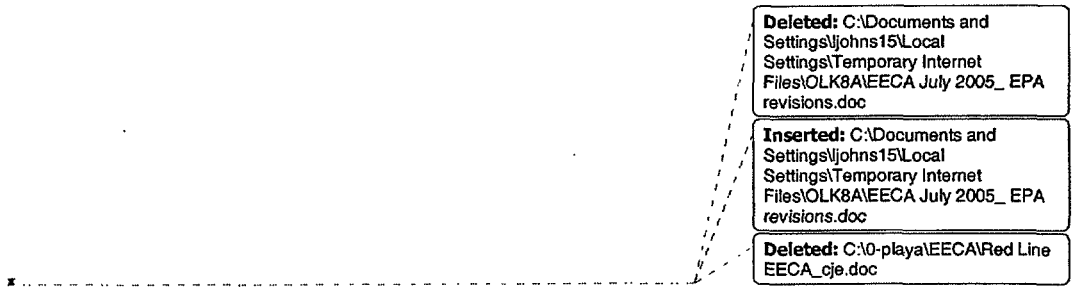

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Figure 4-1 Removal Action Alternative 1

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Figure 4-2 Removal Action Alternative 2

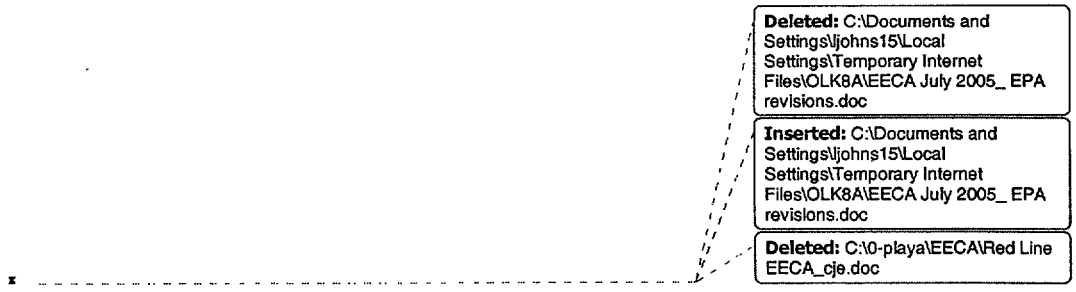

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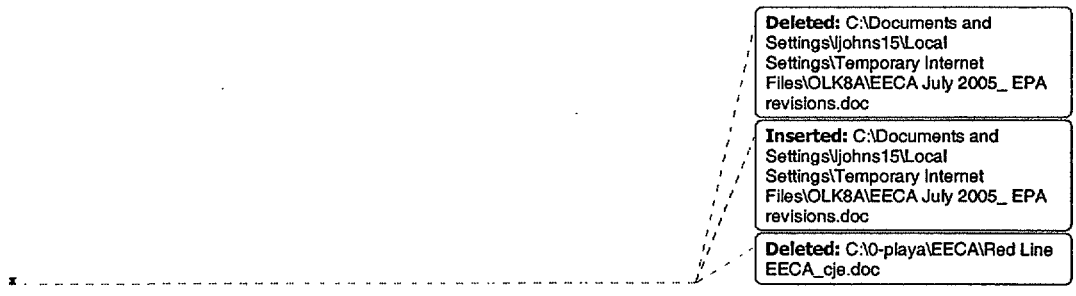
Figure 4-3 Removal Action Alternative 3



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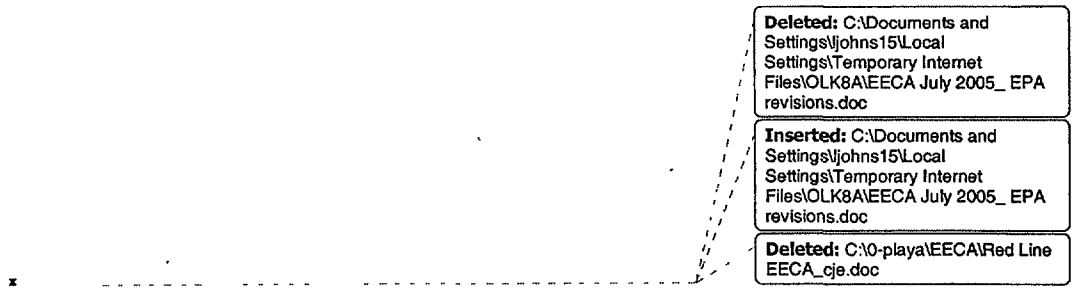

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Section 9
Tables

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Table 5-1
Summary of Cost Estimates

Alternative	Capital Cost	Annual Cost	Present Worth
1	$3,539,000	$329,000	$7,622,000
2	$2,773,000	$296,000	$6,447,000
3	$3,948,000	$482,000	$9,432,000

Comment: This table should have a column indicating the O&M period for each alternative.

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Table 6-1
Summary of Alternatives Evaluation

Criterion	Alternative 1	Alternative 2	Alternative 3
EFFECTIVENESS			
Overall Protection	Low	Moderate	High
Compliance with ARARs	High	High	High
Long-Term Effectiveness	Low	Moderate	High
Treatment	Low	Moderate	High
Short-Term Effectiveness	Moderate	High	Low
IMPLEMENTABILITY			
Technical Implementability	High	High	Moderate
Admin. Implementability	High	High	Low
COST[1]	Moderate	High	Low

[1] A high rating for cost means a relatively low overall cost.

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Appendix A
Miscellaneous Figures and Tables

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Appendix B
Stepwise Human Health Risk Ratio Calculations

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Appendix B
Stepwise Human Health Risk Ratio Calculations

As discussed in Section 2.4, groundwater within the contaminant area (Gage aquifer) is currently not used for domestic, industrial, or agricultural purposes. Use for potable purposes within this area is also unlikely for the future due to the presence of high concentrations of total dissolved solids (TDS). No evidence suggests that contamination extends to any potable aquifer that underlies the Gage aquifer. If future data collection indicates that vertical migration has occurred, then future risk evaluations will address a potential drinking water pathway.

In this appendix section, although ingestion of groundwater from the Gage aquifer is not a completed pathway, a stepwise human health risk ratio evaluation based on this hypothetical exposure pathway was conducted to provide Site management with additional information regarding the magnitude of existing contamination at the Site.

At the Omega Site, risks from contaminated groundwater could theoretically result from volatilization of groundwater contaminants and subsequent intrusion of vapors into indoor spaces. In order evaluate this potential exposure pathway current guidance and practice recognizes that soil gas measurements are necessary to fully support quantitative estimates of impacts to indoor air. The potential for groundwater contaminants to migrate to indoor air will be evaluated along with soil gas and soil contamination in a separate risk assessment to be prepared for the On-Site Soils RI/FS.

Since, the On-Site Soil RI/FS risk assessment will include an evaluation potential migration of subsurface vapors originating from soil to indoor spaces, this stepwise risk evaluation also does not address risks associated with contamination observed in subsurface soil. Finally, ecological impacts from the facility are not expected and are not evaluated, because the Omega facility is located in an urban area that has been developed for decades, provides no suitable habitat, and contaminated soils are covered with buildings, asphalt, or concrete,.

The following documents and others cited within this section form the basis for the stepwise risk evaluation:

- Correspondence from Chris Lichens, EPA Region 9 Superfund Project Manager, to Chuck McLaughlin, OPOG Project Coordinator of de Maximis Inc., on March 18, 2005.
- Guidance on Conducting Non-Time Critical Removals Under CERCLA. EPA, Office of Emergency and Remedial Response. EPA 540-R-93-057, PB93-963402, August 1993.

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- User's Guide and Background Technical Document for USEPA Region 9's Preliminary Remediation Goals (PRG) Table. EPA. 2004.
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A). Interim Final. EPA/5401/1-891002. December 1989.

Per the EPA guidance letter, this appendix provides the following evaluations:

- Comparison of groundwater chemical concentrations in Phase 1a Area wells to MCLs (Federal and State of California) and to current Region 9 Tap Water PRGs
- Cumulative human health risks and hazards for chemicals in groundwater in the Phase 1a Area using the Region 9 stepwise risk ratio approach
- Plots of cumulative risks and hazards for Phase 1a wells.

B.1 Identification of Site Chemicals and Comparison to Risk-Based Guidelines

Groundwater investigations were performed by a variety of consultants to Omega between 1985 and 2005. Only the results for the more recent groundwater sampling events (1996 to 2005) have been entered into a database. Further, because groundwater concentrations vary widely over time, only groundwater data from 2004 and 2005 were used to represent current conditions in this evaluation. Summary statistics for the 2004-2005 groundwater data used in this evaluation are provided in Table B-1.

Toxicity screening using these data was conducted by comparing maximum concentrations of chemicals detected in groundwater with generic risk-based concentrations developed for screening by EPA Region 9.

B.1.1 EPA and CalEPA Maximum Contaminant Levels

Maximum chemical concentrations in groundwater at the Site were compared to maximum contaminant limits (MCLs). and chemical concentrations in groundwater that are protective of indoor air. It should be re-emphasized that use of groundwater as a source of drinking water is not a plausible scenario within the containment zone, and, hence, MCLs may not be pertinent to the remediation of the groundwater in this area.. The comparison of maximum chemical concentrations in groundwater to EPA and CalEPA MCLs is presented in Table B-2.

B.1.2 EPA 2002 Guidance Target Groundwater Concentrations

EPA has developed generic groundwater criteria designed to be protective for vapor intrusion into indoor work spaces. (EPA 2002). These values were calculated assuming an attenuation factor of 0.001 and that partitioning of VOCs between groundwater and soil vapor obeyed Henry's law. An attenuation factor of 0.001 is appropriate to represent an existing commercial building with a slab-on-grade

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foundation (EPA 2003). The EPA guidance document (EPA 2002) provides these generic target media-specific concentrations for target risk concentrations of 10^{-4}, 10^{-5}, and 10^{-6}. Maximum detected concentrations in groundwater were compared to the target risk concentration of 10^{-6} (1 in a million) in Table B-3. The 1 in a million target risk was selected because the EPA uses this target as their point of departure for identifying clean-up goals. . Although vapor migration from groundwater to indoor air is not quantitatively assessed in this report, the comparisons with screening criteria based on such migration does provide a conservative illustration of the potential importance of this migration/exposure pathway. No further assessment of vapor migration of VOCs from groundwater is included in this report

B.1.3 EPA Region 9 Preliminary Remediation Goals

The Region 9 preliminary remediation goals (PRGs) were also used as screening criteria for comparison with maximum detected concentrations. PRGs for groundwater are screening values that have been developed by EPA Region 9 (EPA 2004) based on residential and commercial/industrial exposure assumptions and a target cancer risk of 1×10^{-6} or target hazard quotient (HQ) of 1. For chemicals with carcinogenic as well as noncarcinogenic effects, the lower PRG is used in the screening.

For groundwater, maximum concentrations for each chemical were compared to EPA Region IX tap water screening concentrations. Risk-based concentrations for non-volatile contaminants in tap water are "allowable" concentrations based on potential exposure from ingestion of groundwater. The comparison of maximum detected concentrations in groundwater to PRGs is presented in Table B-3.

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B.1.4 Frequency of Detection

Chemicals that are detected very infrequently at a Site generally are not likely to contribute significantly to overall risk. This is especially true for sites where risks are strongly dominated by a few chemicals; however, due to potential cumulative effects, no detected compounds are eliminated based solely on frequency of detection. Some compounds reported in samples collected from groundwater at the Site were infrequently detected (less than a 5 percent frequency) and generally are not expected to contribute significantly to potential overall risk.

These infrequently detected chemicals are further evaluated to assure that chemicals are not Class A carcinogens (known human carcinogens), are not detected at very high concentrations, and/or are not concentrated in "hotspots." Hotspots are defined as relatively small locations with chemical concentrations that are significantly higher than those in surrounding areas. In most cases, hotspots correlate with source areas. Chemicals classified as known human carcinogens, detected at very high concentrations, or concentrated in a hotspot area could theoretically be significant, even if their site-wide occurrence is low.

Frequency of detection is provided on Tables B-1 through B-3.

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B.2 Exposure Assessment

Exposure is defined as human contact with a chemical or physical agent (EPA 1989). Exposure assessment is the estimation of magnitude, frequency, duration, and pathway(s) of exposure to a chemical. Assessment of exposure consists of three steps:

- Characterization of Exposure Setting
- Identification of Exposure Pathways
- Quantification of Exposure

In this stepwise risk evaluation, cumulative human health risks and hazards for chemicals in groundwater were estimated using Region 9 PRGs by applying the stepwise risk ratio approach. PRGs are developed using appropriate toxicity criteria and standard exposure factors to estimate contaminant concentrations in environmental media that are protective for either residential or commercial/industrial exposures. For groundwater, PRGs consider exposure via ingestion of drinking water, dermal absorption (washing/showering), and inhalation of volatiles (showering). These PRGs do not consider vapor intrusion.

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The Region 9 PRGs for tap water assume ingestion from drinking during residential land use. However, groundwater within the contaminant area is currently not used for any purpose. Future use for potable purposes within this area is also unlikely due to the presence of high concentrations of total dissolved solids (TDS). In addition, the future use of the Site is likely to remain commercial/industrial. . The assessment of risks based on potential domestic use of groundwater at the site is therefore extremely conservative, and serves primarily to provide an illustration of the magnitude of existing contamination.

The site conceptual exposure model for the Site outlining the actual potential receptors and exposure pathways for the Site is provided in Figure B-1.

B.3 Toxicity Assessment

The purpose of toxicity assessment is to review and summarize available information on the potential for each chemical to cause adverse effects in exposed individuals. For most adverse effects caused by chemicals, a positive relationship exists between dose (intake of a chemical through a particular exposure pathway, such as ingestion) and response. Generally, as dose increases, type and severity of adverse response also increases. Further, time of onset of toxic responses often shortens.

In this stepwise risk evaluation, cumulative human health risks and hazards for chemicals in groundwater were estimated using Region 9 PRGs by applying the stepwise risk ratio approach. As such, the toxicity values incorporated into the Region 9 PRGs are used. The user's guide for the PRGs provides a detailed description of the hierarchy of sources for the toxicity values that were used in the development of the

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PRGs. California-modified PRGs (based on CalEPA toxicity values) were used preferentially when available.

B.4 Risk Characterization

The stepwise risk ratio approach for PRG screening of sites with multiple pollutants has three steps:

- Compile existing data (see Table B-1)
- Identify Site contaminants in the PRG Table (see Table B-3)
- Estimate risks and hazards by calculating ratios and summing for multiple chemicals

B.4.1 Cancer Risk

For cancer risk estimates of chemicals designated for cancer evaluation, maximum site-specific concentration of the Phase 1a Area wells was divided by its respective PRG concentration. This ratio was multiplied by 10^{-6} to estimate a reasonable worst-case chemical-specific risk. Risk estimates for individual chemical were then summed to determine a total reasonable worst-case cancer risk for the Site. All detected chemicals were included in this evaluation.

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As shown on Table B-4, the total cancer risk for the Site could theoretically be as high as 2.1. Ninety-eight percent of the cancer risk is due to hypothetical exposure to tetrachloroethene (PCE). To put such risk estimates into perspective, cancer risks of one in one million (1×10^{-6}) or less are considered *de minimis* by EPA and other regulatory agencies.. The National Contingency Plan (NCP) identifies a risk management range of 1×10^{-6} to 1×10^{-4}. EPA has also clarified that the 1×10^{-4} upper boundary is not a discrete line and risks slightly greater than 1×10^{-4} may be acceptable depending on site conditions (EPA 1991). Clearly, hypothetical cancer risks estimated for the site greatly exceed even the upper limit of EPA's risk management range.

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PCE was detected in all of the groundwater samples with the highest concentrations detected in well OW-1. The maximum detected PCE concentration was 210,000 µg/L on August 2004. The most recent sampling in February 2005 indicated a PCE concentration of 170,000 µg/L. PCE concentrations in well OW-8 are a magnitude lower ranging from 3,400 to 68,000 µg/L from February 2004 to February 2005. Although PCE concentrations are lowest at the deeper wells OW-8B and OW-1B ranging from 2.1 to 90 µg/L, the average PCE concentrations at these wells are still high enough to cause a hypothetical cancer risk of greater than 1×10^{-4}.

B.4.2 Noncancer Hazard

For non-cancer risk estimates of chemicals designated for non-cancer evaluation, maximum concentrations observed in Phase 1a Area wells was divided by its

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respective PRG concentration to determine a non-carcinogenic hazard. Individual hazards for each chemical were then summed to determine an overall non-cancer hazard estimate for the Site. All detected chemicals were included in this evaluation. In the development of the PRG value, screening values were calculated for both carcinogenic and noncarcinogenic effects and the more conservative of the two values was presented in the PRG table as the screening value. This means that some carcinogens have an associated non-cancer PRG that is not listed in the PRG table. For these chemicals the unposted non-cancer PRG values were obtained from the PRG InterCalc Tables.

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As shown on Table B-5, the total non-cancer risk for the Site is 4,156. As perspective, a total hazard index that exceeds one may imply some potential for non-cancer health effects following chronic exposure. Ordinarily, total hazard indices would be calculated for groups of chemicals that affect the same target organs or tissues. However, the bulk of the total hazard estimate is due to only two chemicals. Eighty-three percent of the non-cancer hazard is due to hypothetical exposure to PCE and 9% is attributable to trichloroethene (TCE). All other chemicals contribute 3% or less. Thus, the highest total hazard estimates for the site would not be notably different if chemicals were grouped by target organ or tissue prior to calculation of total hazards.

As discussed above, PCE was detected in all of the groundwater samples with the highest concentrations detected in well OW-1 (most recently 170,000 µg/L in February 2005). Although PCE concentrations in well OW-8 are a magnitude lower (ranging from 3,400 to 68,000 µg/L), PCE concentrations are still high enough to cause hypothetical hazards greater than 1. PCE concentrations are lowest in the deeper wells OW-8B and OW-1B ranging from 2.1 to 90 µg/L. The highest concentration results in a hypothetical hazard of 1.5.

TCE was detected in 35 of 37 groundwater samples (95%) with the highest concentrations detected in wells OW-1 and OW-8 (ranging from 1,000 to 3,600 µg/L). TCE concentrations are a magnitude lower in wells OW-2 and OW-3 (ranging from 140 to 490 µg/L), and lowest at the deeper wells OW-8B and OW-1B (ranging from 0.16 to 3.9 µg/L). The TCE noncancer PRG is 9.5 µg/L; concentrations greater than this PRG will result in hypothetical hazards greater than 1.

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B.4.3 Cumulative Risks and Hazards

The Phase 1a wells are OW-1, OW-1A, OW-2, OW-3, OW-8, and OW-8B. All other wells on the Omega facility are either upgradient wells or not within the Phase 1a Area. Due to the small number of wells, risk and hazard isopleths were not developed for the Site. Instead, risks and hazards were developed using the average 2004-2005 Site concentrations. These risks and hazards are summarized on Tables B-6 and B-7 and plotted on Figures B-2 and B-3. Risks and hazards were highest at well location OW-1 and lowest at the deep wells OW-1B and OW-8B. These calculated values are purely hypothetical since use of groundwater at the source for drinking purposes is highly unlikely (see Section 2.9.1.1). These risk and hazard numbers are provided to

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indicate the magnitude of contamination at the source and support a containment action.

B.5 Uncertainties

B.5.1 Uncertainties in the Database

Site data for groundwater provide an adequate characterization of current groundwater conditions at the Site. However, data may not be fully adequate for determining future trends in soil gas contaminant concentrations. Since the database is a "snapshot" in time, it is not possible to determine with absolute certainty if vapor concentrations are likely to increase, decrease, or remain constant in the future. However, it is reasonable to assume that existing groundwater concentrations and, hence, volatilization therefrom, are not likely to increase significantly in the future.

B.5.2 Uncertainties with Exposure Assessment

The exposure assessment is based on a hypothetical drinking water scenario that is highly unlikely to ever be complete for the site. Risks presented in this appendix are not expressions of any risk that may actually be associated with VOCs in groundwater. However, given that the calculations were carried out, the following uncertainties pertain.

Quantitative estimates of chemical exposure may contain significant uncertainty. Exposure assumptions used in the development of PRGs are derived from a combination of USEPA and CalEPA guidance, site-specific information, and professional judgment, with each of the potential information sources being subject to uncertainty. The combination of exposure assumptions and exposure point concentrations used in the assessment is expected to provide conservative estimates for exposure of individuals at the Site. However, uncertainties and their potential impacts on use of risk results for risk management should be understood. In particular, the tap water PRGs were developed assuming a residential exposure. Because the Omega facility is an industrial site that is expected to remain industrial, using the PRGs that assume a residential scenario to calculate risks and hazards will over-estimate risks.

B.5.3 Uncertainties Associated with Toxicity Assessment

A potentially large source of uncertainty is inherent in the derivation of the EPA toxicity criteria (i.e., RfDs, and cancer slope factors). In many cases, data must be extrapolated from animals to sensitive humans by the application of uncertainty factors to an estimated no observable adverse effect levels (NOAELs) or low observable adverse effect levels (LOAEL) for non-cancer effects. While designed to be protective, it is likely in many cases that uncertainty factors overestimate the magnitude of differences that may exist between human and animals, and among humans.

In some cases, however, toxicity criteria may be based on studies that did not detect the most sensitive adverse effects. For example, many past studies have not measured

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possible toxic effects on the immune system. Moreover, some chemicals may cause subtle effects not easily recognized in animal studies. The effects of lead on cognitive function and behavior at very low levels of exposure serve as examples.

In addition, derivation of cancer slope factors often involves linear extrapolation of effects at high doses to potential effects at lower doses commonly seen in environmental exposure settings. Currently, it is not known whether linear extrapolation is appropriate. Probably, the shape of the dose response curve for carcinogenesis varies with different chemicals and mechanisms of action. It is not possible at this time, however, to describe such differences in quantitative terms.

It is likely that the assumption of linearity is conservative and yields slope factors that are unlikely to lead to underestimation of risks. Yet, for specific chemicals, current methodology could cause slope factors, and, hence, risks, to be underestimated.

Use of the CalEPA toxicity criteria could either over or underestimate potential risks, but it is difficult to determine either the direction or magnitude of any errors. In general, however, it is likely that the criteria err on the side of protectiveness for most if not all chemicals.

B.5.4 Uncertainties with Risk Characterization

B.5.4.1 Cancer Risks

Theoretical cancer risk is typically described in terms of the number of additional cases of cancer projected to occur in a population due to exposure to a cancer-causing substance over a lifetime. For example, a cancer risk of 1×10^{-6} (one in a million) means that not more than one person out of one million would be expected to develop cancer as a result of exposure to the cancer-causing substance.

Total cancer risk from exposure to groundwater at the Site is 2.1, which is several orders of magnitude above the EPA risk management range of 1×10^{-6} to 10×10^{-4}. This extremely high value is an artifact of the risk estimation process used in this screening-level assessment. Extremely high concentrations of chemicals, particularly PCE, were assumed to be present in drinking water for decades. In fact, at the concentrations observed, one would expect avoidance of water due to taste and odor problems and/or shorter-term noncancer toxic effects. In essence, methods for estimating cancer risk assume that exposures will be to relatively low concentrations of chemicals -- these methods do not provide an accurate reflection of potential cancer risks when exposure concentrations are assumed to be orders of magnitude higher than those that would typically be of concern.

In addition, as noted in Section 2.9.1.1, calculated risk values are purely hypothetical since it is unlikely that groundwater at the source would be used for potable water. Risk estimates are provided in this report to indicate the magnitude of contamination at the source and support a containment action.

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B.5.4.2 Exposure to Chemicals without PRGs

A number of chemicals detected at the Omega Site do not have tap water PRGs. These chemicals are listed in Table B-8. Some of these chemicals are essential minerals - sodium, potassium, magnesium, chloride, etc. – and their exclusion from the risk assessment does not affect results. However, some chemicals without PRGs can be associated with adverse effects.

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For example, the PRG table does not list a tap water PRG for lead. As such, the risks from exposure to lead were not calculated using the stepwise PRG approach. Risks and hazards from lead are usually calculated using the EPA Adult Lead model, the DTSC Leadspread model or EPA's Integrated Exposure Uptake Biokinetic mode. Lead is classified as a probable human carcinogen, group B2 carcinogen, which means there is sufficient evidence of carcinogenicity in animals. Not including risk and hazards from lead may result in some underestimate of hypothetical cancer risk. Because the Site's overall risk and hazard already indicate that exposure is greater than that considered safe, not including lead's contribution does not change the outcome of this evaluation.

B.6 Summary

The results of the stepwise risk evaluation for groundwater within the containment zone and the RI/FS for soil at the Omega Facility indicate that there is a need for remedial action if groundwater is to be used for as a source of potable water. The total cancer risk from groundwater at the Site is 2.1, which is several orders of magnitude above the EPA risk management range of 1×10^{-6} to 10×10^{-4}. Similarly, the total non-cancer risk for the Site is 4,156, significantly greater than the acceptable threshold of 1.

Because groundwater within the contaminant area (Gage aquifer) is currently not used and it is unlikely that it will be used for potable purposes in the future due to high concentrations of TDS, these calculated risks represent an unlikely future scenario. Further, tap water PRGs were developed assuming a residential exposure. Because the Omega facility is an industrial site that is expected to remain industrial, calculating site risks using these PRGs, which assume a residential scenario, over-estimates risks. In addition, because groundwater at the site is greater than 70 feet below ground surface, off-gassing from groundwater is not expected to result in unacceptable risks. As noted previously, this stepwise human health risk ratio evaluation was conducted to provide Site management with additional information regarding potential health risk issues at the Site.

This EE/CA is focused on the limiting migration of VOCs in groundwater and this focus is consistent with the findings of the risk evaluation. Exposure to soil and soil gas will be evaluated in a separate risk assessment for the On-Site Soils RI/FS.

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Comments on Appendix B Tables

Table B-2, Comparison of Maximum Detected Groundwater Concentrations in Phase 1a Wells to EPA Maximum Contaminant Levels (MCLs) and Cal EPA MCLs.

The CalEPA MCL for nitrate (as NO3); 45,000 ug/l, should be edited to indicate that the parameter is "NITRATE (AS NO3)".

Table B-3, Comparison of Maximum Detected Groundwater Concentrations.

Column 2 of Table B-3 presents "EPA 2002 Guidance Target Groundwater Concentration":

- Trichloroethene: Insert: "**5 ug/l**"

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Column 3 of Table B-3 presents Region IX Tap Water PRGs (ug/l).

- For Chloroform include both: **0.17 * ug/l; Cal-Modified 0.53 * ug/l**
- For Trichloroethene include both: **0.028 * ug/l; Cal-Modified 1.40 * ug/l**

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Appendix C
Details of Cost Estimates

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Appendix D
Conceptual Design Basis

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Appendix E
Description of EAB Technology

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